

Project Manual

# BOTTINEAU RIDGE II APARTMENTS

Maple Grove, Minnesota

**100% Construction Documents**



**Minneapolis**

322 First Avenue N, #600

Minneapolis, MN 55401

p 612.746.4260

Project Number: JLG 16098

Date: December 4, 2017

Project Manual # \_\_\_\_\_

2017 JLG ARCHITECTS



## **SECTION 00 0110 - TABLE OF CONTENTS**

### **PROCUREMENT AND CONTRACTING REQUIREMENTS**

#### **Division 00 -- Procurement and Contracting Requirements**

- 00 0105 – Certification Page
- 00 0110 - Table of Contents
- 00 1113 – Invitation for Bids
- 00 2113 - Instructions to Bidders
- 00 2600 - Procurement Substitution Procedures
- 00 3100 - Available Project Information
- 00 4100 – Bid Form
- 00 5000 - Contracting Forms and Supplements
- 00 7300 - Supplementary Conditions
  - Section 3 Contracting Clause of the Housing and Urban Development Act of 1968

### **SPECIFICATIONS**

#### **Division 01 -- General Requirements**

- 01 2000 - Price and Payment Procedures
- 01 2100 - Allowances
- 01 2300 – Alternates
  - Alternate No. 1 Design Narrative
- 01 2500 - Substitution Procedures
- 01 3000 - Administrative Requirements
- 01 3216 - Construction Progress Schedule
- 01 3329 – Green Building Requirements
- 01 4000 - Quality Requirements
- 01 4533 - Code-Required Special Inspections
- 01 5000 - Temporary Facilities and Controls
- 01 5721 - Indoor Air Quality Controls
- 01 5813 - Temporary Project Signage
- 01 6000 - Product Requirements
- 01 6116 - Volatile Organic Compound (VOC) Content Restrictions
- 01 7000 - Execution and Closeout Requirements
- 01 7419 - Construction Waste Management and Disposal
- 01 7800 - Closeout Submittals

#### **Division 03 -- Concrete**

- 03 2000 - Concrete Reinforcing
- 03 3000 - Cast-in-Place Concrete
- 03 4100 - Precast Structural Concrete
- 03 5400 - Cast Underlayment

#### **Division 04 -- Masonry**

- 04 2000 - Unit Masonry
- 04 7200 - Cast Stone Masonry

**Division 05 -- Metals**

- 05 5000 - Metal Fabrications
- 05 5913 – Metal Balconies

**Division 06 -- Wood, Plastics, and Composites**

- 06 1000 - Rough Carpentry
- 06 1753 - Shop-Fabricated Wood Trusses
- 06 2000 - Finish Carpentry

**Division 07 -- Thermal and Moisture Protection**

- 07 1300 - Sheet Waterproofing
- 07 2100 - Thermal Insulation
- 07 2119 - Foamed-In-Place Insulation
- 07 2126 - Blown Insulation
- 07 2500 - Weather Barriers
- 07 3113 - Asphalt Shingles
- 07 4633 – Plastic Siding
- 07 5300 – Elastomeric Membrane Roofing
- 07 6200 - Sheet Metal Flashing and Trim
- 07 8400 - Firestopping
- 07 9200 - Joint Sealants

**Division 08 -- Openings**

- 08 1113 - Hollow Metal Doors and Frames
- 08 1213 - Hollow Metal Frames
- 08 1416 - Flush Wood Doors
- 08 1450 – Prehung Wood Doors
- 08 3100 - Access Doors and Panels
- 08 3613 - Sectional Doors
- 08 4313 - Aluminum-Framed Storefronts
- 08 5313 - Vinyl Windows
- 08 7100 - Door Hardware
- 08 8000 - Glazing

**Division 09 -- Finishes**

- 09 2116 - Gypsum Board Assemblies
- 09 3000 - Tiling
- 09 5100 – Suspended Acoustical Ceilings
- 09 6500 - Resilient Flooring
- 09 6800 - Carpeting
- 09 9113 - Exterior Painting
- 09 9123 - Interior Painting

**Division 10 -- Specialties**

- 10 1101 - Visual Display Boards
- 10 1400 - Signage
- 10 2800 - Toilet, Bath, and Laundry Accessories
- 10 3100 - Manufactured Fireplaces
- 10 4400 - Fire Protection Specialties
- 10 5500 - Postal Specialties
- 10 5623 - Wire Storage Shelving

**Division 11 -- Equipment**

11 3100 - Residential Appliances

**Division 12 -- Furnishings**

12 2113 - Horizontal Louver Blinds  
12 2116 - Vertical Louver Blinds  
12 3530 - Residential Casework  
12 3600 - Countertops  
12 4813 - Entrance Floor Mats and Frames

**Division 14 -- Conveying Equipment**

14 2400 - Hydraulic Elevators  
14 9100 - Facility Chutes

**Division 21 -- Fire Suppression**

21 0500 -- Common Work Results for Fire Suppression  
21 1313 -- Sprinkler Systems

**Division 22 - Plumbing**

22 0500 -- Common Work Results for Plumbing  
22 0519 -- Meters and Gages for Plumbing Piping  
22 0523 -- General-Duty Valves for Plumbing Piping  
22 0529 -- Hangers and Supports for Plumbing Piping and Equipment  
22 0553 -- Identification for Plumbing Piping and Equipment  
22 0700 -- Plumbing Insulation  
22 1116 -- Domestic Water Piping  
22 1119 -- Domestic Water Piping Specialties  
22 1316 -- Sanitary Waste and Vent Piping  
22 1319 -- Sanitary Waste Piping Specialties  
22 3100 -- Domestic Water Softeners  
22 4000 -- Plumbing Fixtures

**Division 23 -- Heating, Ventilating, and Air-Conditioning**

23 0500 -- Common Work Results for HVAC  
23 0513 -- Common Motor Requirements for HVAC Equipment  
23 0514 -- Variable Frequency Drives  
23 0516 -- Expansion Fittings and Loops for HVAC Piping  
23 0519 -- Meters and Gages for HVAC Piping  
23 0523 -- General-Duty Valves For HVAC Piping  
23 0529 -- Hangers and Supports for HVAC Piping and Equipment  
23 0553 -- Identification for HVAC Piping and Equipment  
23 0593 -- Testing, Adjusting, and Balancing  
23 0700 -- HVAC Insulation  
23 0900 -- Instrumentation and Control for HVAC  
23 0993 -- Sequence of Operations for HVAC Controls  
23 1123 -- Facility Natural-Gas Piping  
23 2113 -- Hydronic Piping  
23 3113 -- Metal Ducts  
23 3300 -- Air Duct Accessories

- 23 3423 – HVAC Power Ventilators
- 23 3713 – Diffusers, Registers, and Grilles
- 23 5216 – Condensing Boilers
- 23 6313 – Air Cooled Refrigerant Condensers
- 23 8126 – Split-System Air-Conditioners
- 23 8219 – Fan Coil Units
- 23 8233 – Convectors
- 23 8239 – Unit Heaters

**Division 26 - Electrical**

- 26 0000 – Electrical General Requirements
- 26 0100 – Electrical Systems Close Out Documentation
- 26 0500 – Common Work Results for Electrical
- 26 0519 – Low Voltage Electrical Power Conductors and Cables
- 26 0526 – Grounding and Bonding for Electrical Systems
- 26 0533 – Raceway and Boxes for Electrical Systems
- 26 0553 – Identification for Electrical Systems
- 26 0560 – Underground Work for Electrical Systems
- 26 0813 – Testing of Electrical Systems
- 26 0920 – Lighting Control Devices and Systems
- 26 2000 – Low Voltage Electrical Distribution Equipment
- 26 2726 – Wiring Devices
- 26 4300 – Surge Protective Devices
- 26 5100 – Lighting Fixtures and Luminaires

**Division 27 - Communications**

- 27 0528 – Pathways for Communications Systems
- 27 1000 – Communications Structured Cabling Systems

**Division 28 – Electronic Safety and Security**

- 28 3113 – Fire Alarm and Detection System

**Division 31 -- Earthwork**

- 31 1010 – Site Clearing
- 31 2000 - Earthwork
- 31 2316 – Excavation
- 31 2317 - Trenching
- 31 2323 – Fill
- 31 2513 – Erosion Controls

**Division 32 -- Exterior Improvements**

- 32 1123 – Aggregate Base Course
- 32 1216 – Asphalt Paving
- 32 1313 – Concrete Paving
- 32 1723 – Pavement Marking
- 32 5800 - Landscaping

**Division 33 -- Utilities**

- 33 1116 – Water Utility Distribution Piping
- 33 3000 – Sanitary Sewerage Utilities
- 33 4000 – Storm Drainage Utilities

33 4600 – Subdrainage

**END OF SECTION**





**SECTION 00 0105 - CERTIFICATIONS PAGE**

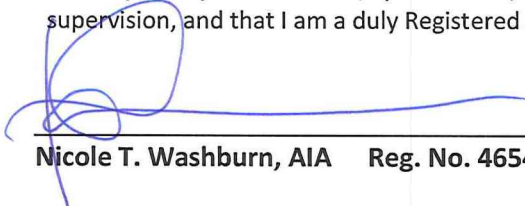
**BOTTINEAU RIDGE II APARTMENTS**

**MAPLE GROVE, MINNESOTA**

**CERTIFICATIONS**

**Architectural**

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision, and that I am a duly Registered Architect under the laws of the State of Minnesota.



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**Nicole T. Washburn, AIA    Reg. No. 46546    December 4, 2017**

**Civil**

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision, and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



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**Jeremy E. Anderson, P.E.    Reg. No. PE-44223    December 4, 2017**

**Structural**

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision, and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



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**Kurt Sandman, P.E.    Reg. No. PE-43486    December 4, 2017**

**Mechanical**

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision, and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



12/4/17

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**Jon D. Wessling, P.E.    Reg. No. PE-43950    December 4, 2017**

**Electrical**

I hereby certify that this Plan, Specification, or Report was prepared by me or under my direct supervision, and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



Jeff W. Besel, P.E.

Reg. No. PE-44225

December 4, 2017

**END OF SECTION**

## **SECTION 00 1113 - INVITATION FOR BIDS**

### **BOTTINEAU RIDGE II APARTMENTS**

MAPLE GROVE, MINNESOTA

Sealed proposals for General, Mechanical, Electrical, and Civil Construction for the Bottineau Ridge II Apartments project will be received by the Owner at the office of JLG Architects, 322 First Avenue N, Suite 600, Minneapolis, MN, until 12:00 PM local time on Thursday, December 14, 2017, when bids will be opened privately with the Owner.

The Information to Bidders, Form of Bid, Form of Contract, Drawings, Specifications, addenda, and other contract documents as prepared by JLG Architects; DesignTree Engineering and ONE; may be examined at the office of JLG Architects.

No bidder may withdraw their bid within 60 days after the actual date of the opening thereof.

Bids shall be in accordance with and submitted on the Bid form supplied within the Bid Documents. Failure to do so may result in rejection of the Bid. The Owner reserves the right to reject any and all bids and to waive any formalities therein, and rebid the project until a satisfactory bid is received.

**END OF SECTION**



## **SECTION 00 2113 - INSTRUCTIONS TO BIDDERS**

### **PART 1 GENERAL**

#### **1.01 DEFINITIONS**

- A. Bidding Documents include the Bidding Requirements and the proposed Contract Documents. The Bidding Requirements consist of the Advertisement or Invitation to Bid, Instructions to Bidders, Bid Form, and other sample bidding and contract forms. The proposed Contract Documents consist of the form of Agreement between the Owner and Contractor, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and all addenda issued prior to execution of the Contract.
- B. Definitions set forth in the General Conditions of the Contract for Construction, AIA Document A201, or in other Contract Documents are applicable to the Bidding Documents.
- C. Addenda are written or graphic instruments issued by the Architect prior to the execution of the Contract which modify or interpret the Bidding Documents by additions, deletions, clarifications, or corrections.
- D. A Bid is a complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- E. The Base Bid is the sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids.
- F. An Alternate Bid (or Alternate) is an amount stated in the Bid to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents, is accepted.
- G. A Bidder is a person or entity who submits a Bid and who meets the requirements set forth in the Bidding Documents.
- H. A Sub-bidder is a person or entity who submits a bid to a Bidder for materials, equipment, or labor for a portion of the Work.

#### **1.02 BIDDER'S REPRESENTATIONS**

- A. The Bidder by making a Bid represents that:
  - 1. The Bidder has read and understands the Bidding Documents or Contract Documents, to the extent that such documentation relates to the Work for which the Bid is submitted, and for other portions of the Project, if any, being bid concurrently or presently under construction.
  - 2. The Bid is made in compliance with the Bidding Documents.
  - 3. The Bidder has visited the site, become familiar with local conditions under which the Work is to be performed and has correlated the Bidder's personal observations with the requirements of the proposed Contract Documents.
  - 4. The Bid is based upon the materials, equipment, and systems required by the Bidding Documents without exception.

#### **1.03 BIDDING DOCUMENTS**

- A. Copies:

1. Prime bidders may obtain complete sets of the Bidding Documents from the issuing office designated in the Advertisement or Invitation to Bid.
2. Bidding Documents may not be issued directly to Sub-bidders unless specifically offered in the Advertisement or Invitation to Bid, or in supplementary instruction to bidders.
3. Bidders shall use complete sets of Bidding Documents in preparing Bids; neither the Owner nor Architect assumes responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
4. The Owner and Architect may make copies of the Bidding Documents available on the above terms for the purpose of obtaining Bids on the Work. No license or grant of use is conferred by issuance of copies of the Bidding Documents.

#### **1.04 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS**

- A. The Bidder shall carefully study and compare the Bidding Documents with each other, and with other work being bid concurrently or presently under construction to the extent that it relates to the Work for which the Bid is submitted, shall examine the site and local conditions, and shall at once report to the Architect errors, inconsistencies, or ambiguities discovered.
- B. Bidders and Sub-bidders requiring clarification or interpretation of the Bidding Documents shall make a written request which shall reach the Architect at least seven days prior to the date for receipt of Bids.
- C. Interpretations, corrections, and changes to the Bidding Documents shall be made by Addendum. Interpretations, corrections, and changes to the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon them.

#### **1.05 SUBSTITUTIONS**

- A. The materials, products, and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance, and quality to be met by any proposed substitution.
- B. No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least seven days prior to the date for receipt of Bids. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the Work, including changes in the work of other contracts that incorporation of the proposed substitution would require, shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Architect approves a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner.
- D. No substitutions will be considered after the Contract award unless specifically provided for in the Contract Documents.

#### **1.06 ADDENDA**

- A. Addenda will be transmitted to all who are known by the issuing office to have received a complete set of Bidding Documents.
- B. Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

- C. Addenda will be issued no later than three days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which includes postponement of the date for receipt of Bids.
- D. Each bidder shall ascertain prior to submitting a Bid that the Bidder has received all Addenda issued, and the Bidder shall acknowledge their receipt in the Bid.

#### **1.07 PREPARATION OF BIDS**

- A. Bids shall be submitted on the forms included with the Bidding Documents.
- B. All blanks on the bid form shall be legibly executed in a non-erasable medium.
- C. Sums shall be expressed in both words and figures. In case of discrepancy, the amount written in words shall govern.
- D. Interlineations, alterations, and erasures must be initialed by the signer of the Bid.
- E. It is requested that a change in cost be submitted for all Alternates. Failure to submit a cost change for an alternate may result in the Owner not being able to put together the project desired and cause the bid to not be considered. If no change in the Base Bid is required, enter "No Change."
- F. Where two or more Bids for designated portions of the Work have been requested, the Bidder may, without forfeiture of the bid security, state the Bidder's refusal to accept award of less than the combination of Bids stipulated by the Bidder. The Bidder shall make no additional stipulations on the bid form nor qualify the Bid in any other manor.
- G. Each copy of the Bid shall state the legal name of the Bidder and the nature of legal form of the Bidder. The Bidder shall provide evidence of legal authority to perform within the jurisdiction of the contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current power of attorney attached certifying the agents authority to bind the Bidder.

#### **1.08 RECEIPT AND OPENING OF BIDS**

- A. Bids shall be received by the Owner as defined in the Advertisement or Invitation for Bids - Section 00 1113.
- B. Bids shall be deposited at the designated location prior to the time and date for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.
- C. The Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids.
- D. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. No bidder may withdraw a bid within 60 days after the actual date of opening thereof.
- E. The Owner will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn or (c) all Bids have been rejected.

### **1.09 SUBMISSION OF BIDS**

- A. Each bid must be submitted in a sealed envelope bearing the following information on the outside:
  - 1. NAME OF THE PROJECT:
  - 2. NAME OF THE BIDDER:
  - 3. ADDRESS OF THE BIDDER:
  - 4. The words: BID PROPOSAL FOR CONSTRUCTION WORK.
- B. Bids will also be accepted via email. Send bids to [jvonfeldt@duffydevelopment.com](mailto:jvonfeldt@duffydevelopment.com). Subject line shall state "Bid Proposal for Construction Work - Bottineau Ridge II Apartments".
- C. Oral, telephonic, telegraphic, or facsimile transmitted bids will not be considered.

### **1.10 SUBCONTRACTS**

- A. The bidder is specifically advised that any person, firm, or other party to whom it is proposed to award a subcontract under this contract must be acceptable to the Owner. Cause for rejection include, but are not limited to the following:
  - 1. Unacceptable workmanship on past projects.
  - 2. Lack of cooperation and/or inability to meet construction schedules on past projects.
  - 3. Inadequate personnel to meet construction schedule.
- B. The selected bidder must submit to the Architect a complete list of all suppliers and subcontractors within seven days after the date of the bid. Inability to provide a list of acceptable subcontractors shall be just cause for rejection of the bidder's proposal.

### **1.11 MODIFICATION OF BIDS**

- A. A Bid may not be modified, withdrawn, or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.
- B. Prior to the time and date designated for receipt of Bids, a Bid submitted may be modified or withdrawn by notice to the party receiving Bids at the place designated for receipt of Bids. Such notice shall be in writing over the signature of the Bidder. Written confirmation over the signature of the Bidder shall be received, and date- and time-stamped by the receiving party on or before the date and time set for receipt of Bids. A change shall be so worked as not to reveal the amount of the original Bid.
- C. Withdrawn Bids may be resubmitted to the date and time designated for the receipt provided that they are then fully in conformance with these Instructions to Bidder.

### **1.12 CONSIDERATION OF BIDS**

- A. Opening of Bids: Bids will be opened privately.
- B. Rejection of Bids: The Owner shall have the right to reject any or all Bids. A Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or a Bid which is in any way incomplete or irregular is subject to rejection.
- C. Acceptance of Bid (Award)
  - 1. It is the intent of the Owner to award a Contract to the the Bidder, by a combination of criteria including price and previous experiences, provided the Bid has been submitted in accordance with the requirements of the Bidding Documents and does not exceed the funds available. The Owner



shall have the right to waive informalities and irregularities in a Bid received and to accept the Bid which, in the Owner's judgement, is in the Owner's own best interests.

2. The Owner shall have the right to accept Alternates in any order or combination, unless otherwise specifically provided in the Bidding Documents, and to determine the low Bidder on the basis of the sum of the Base Bid and Alternates accepted.

#### **1.13 TIME OF COMPLETION**

- A. Bidder agrees to commence work on or before a date to be specified in a written Notice to Proceed by the Owner and to fully complete the Construction Work as outlined in the project documents and as based on project alternates taken.
- B. Anticipated Start Date is January 15, 2018.
- C. Date of Substantial Completion: Contractor shall indicate their proposed Substantial Completion date on their Bid Form.

#### **1.14 LIQUIDATED DAMAGES**

- A. If the Work is not Substantially Complete on or before the date specified or other date as granted by Change Order, the Contractor shall pay to the Owner as liquidated damages the sum of \$30,000 the first day and \$500 for each additional calendar day of delay. Any monies due to the Owner as liquidated damages will be deducted from any monies due or to become due to the Contractor under the Contract, or will be collected from the Contractor's surety.

#### **1.15 CONDITIONS OF WORK**

- A. Each bidder must inform themselves fully of the conditions relating to the construction of the project. Failure to do so will not relieve a successful bidder of their obligation to furnish all materials and labor necessary to carry out their work and must employ such methods and/or means as will not cause any interruption of, or interference with the work of any other contractor.

#### **1.16 BUILDING PERMIT**

- A. The General Contractor shall include the cost of the building permit in their bid.

#### **1.17 BUILDER'S RISK INSURANCE**

- A. The Owner will provide Builder's Risk Insurance.
- B. See Section 00 7300 - Supplementary Conditions paragraph 11.3.1 for additional information.

#### **1.18 SECURITY FOR FAITHFUL PERFORMANCE**

- A. Simultaneously with their delivery of the executed contract, each contractor shall furnish a Performance-Payment Bond as security for faithful performance of this contract and furnishing materials in connection with this contract. The surety on such bond or bonds shall be a duly authorized surety company satisfactory to the Owner. The amount of the bonds shall be 100% of the contract.

#### **1.19 POWER OF ATTORNEY**

- A. Attorneys-in-fact who sign bonds on contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

## **1.20 LAWS AND REGULATIONS**

- A. The bidder's attention is directed to the fact that all applicable State laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout and they will be deemed to be included in the contract the same as though herein written out in full.

## **1.21 OBLIGATION OF BIDDER**

- A. At the time of the opening of bids, each bidder will be presumed to have inspected the site and to have read and become thoroughly familiar with the plans and contract documents (including all addenda). The failure or omission of any bidder to examine any form, instrument, or document shall in no way relieve any bidder from any obligation in respect to their bid.

## **1.22 STATE EXCISE AND USE TAX (SALES TAX)**

- A. In submitting the bid, the bidder is understood to have included in the bid price the state tax on all sales of building materials, supplies, and equipment to contractors, subcontractors, or builders for the erection of buildings or their alteration, repair, or improvement.

## **1.23 STORING MATERIALS OFF-SITE**

- A. If it is desired by the Contractor to order and store materials off-site, there shall be prior agreement to any arrangement by the Owner and Architect before ordering or Application for Payment. Evidence shall be furnished to the Owner and Architect that the materials have been ordered, delivered and paid for. A Certificate of Insurance for materials stored off-site shall accompany other required information at the time of the Application for Payment. The location of the stored materials shall be acceptable to the Owner.

## **1.24 OWNER REQUIREMENTS OF THE CONTRACTOR**

- A. For Contract language that will be incorporated into AIA Owner-Contractor Agreements, see Project Manual Section 00 5000.

## **PART 2 PRODUCTS (NOT USED)**

## **PART 3 EXECUTION (NOT USED)**

## **END OF SECTION**

# **SECTION 00 2600 - PROCUREMENT SUBSTITUTION PROCEDURES**

## **PART 1 GENERAL**

### **1.01 SUMMARY**

- A. Section Includes
  - 1. Requirements for submitting substitution requests for materials, products, equipment and methods of construction from those required by the Procurement Documents, during the procurement phase and prior to execution of the Owner/Contractor Agreement.

### **1.02 SUBSTITUTIONS (DURING THE PROCUREMENT/BIDDING PHASE)**

- A. The technical specification sections may have several materials, products, equipment and methods of construction specified under the same heading. Selection of a specified materials, products, equipment and methods of construction shall be at the option of the Bidder. Where materials, products, equipment and methods of construction are specified accompanied with the phrase "Or Equal", "Approved Substitution", or similar verbiage, the Bidder may submit materials, products, equipment and methods of construction for approval in accordance with the requirements of this Document.
- B. No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect (or Construction Manager as applicable) at least seven working days prior to the date for receipt of Bids.
  - 1. Submit each request for substitution on the Architect's "Procurement Substitution Request Form" included at the end of this Section.
  - 2. Submit one materials, products, equipment and methods of construction per request form, either duplicated from the Project Manual or available from the Architect's office.
  - 3. Submittals not accompanied by this form properly filled in and endorsed, will be discarded without review. NO EXCEPTIONS.
  - 4. Where specified materials, products, and equipment are accompanied by a color, pattern or finish selection, requests for substitution shall include an actual sample of the proposed color, pattern or finish for review.
  - 5. Where multiple materials, products or equipment are specified within a single specification section, specifically identify which product you wish to substitute.
- C. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or rejection of a proposed substitution shall be final.
- D. Materials, products, equipment and methods of construction approved by this substitution procedure will be issued in an Addendum.
- E. Refer to Section 01 2500 for requests for substitutions after execution of the Owner/Contractor Agreement.

## **PART 2 PRODUCTS (NOT USED)**

## **PART 3 EXECUTION (NOT USED)**

## **END OF SECTION**

# PROCUREMENT SUBSTITUTION REQUEST FORM

TO: JLG Architects  
322 First Avenue North, Suite 600  
Minneapolis, MN 55401

Phone: 612-436-0096  
Contact: Dave Morck  
[dmorck@jlgarchitects.com](mailto:dmorck@jlgarchitects.com)

PROJECT: Bottineau Ridge II Apartments, Maple Grove, Minnesota

Section Number \_\_\_\_\_ Section Title \_\_\_\_\_

Specified Product \_\_\_\_\_

Proposed Substitution \_\_\_\_\_

**All of the following questions must be answered. Incomplete forms will be not be reviewed.**

- A. The following supporting data is attached:  
 Drawings     Product Data     Samples     Tests     Reports
- B. Does the proposed substitution affect dimensions shown on Drawings, or functional clearances?  
 YES     NO
- C. Does the proposed substitution change the design or details shown on the Drawings?  
 YES     NO
- D. Does the proposed substitution affect other trades?  
 YES     NO
- E. Does the proposed substitution affect maintenance service, or source of replacement parts, if applicable?  
 YES     NO
- F. Does the proposed guarantee or warranty differ from that specified?  
 YES     NO
- G. If you indicated "YES" to Items B, C, D, E or F above, attach a thorough explanation on your company letterhead.
- H. If there are other major differences between proposed substitution and specified product, attach a thorough explanation on your company letterhead.
- I. The proposed substitution was used within the last 24 months on the following project:  
Project Name \_\_\_\_\_  
Location \_\_\_\_\_  
Architect \_\_\_\_\_ Telephone No. \_\_\_\_\_
- J. Has the proposed substitution been used on a JLG Architects project within the last 12 months?  
 YES     NO  
If yes, which project? \_\_\_\_\_
- K. The undersigned states that the function, appearance and quality of the substitution item are equivalent or superior to the specified item.

**Submitted By:**

Signature \_\_\_\_\_ Firm \_\_\_\_\_

Address \_\_\_\_\_

Telephone \_\_\_\_\_ Fax \_\_\_\_\_

Date \_\_\_\_\_ E-Mail \_\_\_\_\_

**For Use By Design Consultant:**

- Accepted     Accepted As Noted     Not Accepted     Received Too Late

Name \_\_\_\_\_ Signature \_\_\_\_\_

Date \_\_\_\_\_ Remarks \_\_\_\_\_

## **SECTION 00 3100 - AVAILABLE PROJECT INFORMATION**

### **PART 1 GENERAL**

#### **1.01 EXISTING CONDITIONS**

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders and is included for their reference following this section:
- B. Geotechnical Report: Entitled Bottineau Ridge Phase II Apartments, dated 12/16/2016, and prepared by Braun Intertec.
  - 1. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect/Structural Engineer.
  - 2. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.

### **PART 2 PRODUCTS (NOT USED)**

### **PART 3 EXECUTION (NOT USED)**

### **END OF SECTION**

# Geotechnical Evaluation Report

Bottineau Ridge Phase II Apartments  
Northwest Quadrant of Intersection of Arbor Lakes Parkway and  
Hemlock Avenue  
Maple Grove, Minnesota

*Prepared for*

**Duffy Development, Inc.**

## **Professional Certification:**

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

*Daniel B. Mahrt* Dec 16 2016 12:30 PM

Daniel B. Mahrt, PE  
Associate Principal – Principal Engineer  
License Number 42729  
December 16, 2016

Project B1611164

Braun Intertec Corporation

December 16, 2016

Project B1611164

Mr. John Duffy  
Duffy Development, Inc.  
11900 Wayzata Boulevard, Suite 216  
Minnetonka, MN 55305

Re: Geotechnical Evaluation  
Bottineau Ridge Phase II Apartments  
Northwest Quadrant of Intersection of Arbor Lakes Parkway and Hemlock Avenue  
Maple Grove, Minnesota

Dear Mr. Duffy:

We are pleased to present this Geotechnical Evaluation Report for the Phase II of the Bottineau Ridge Apartment complex.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Dan Mahrt at 651.487.7031 (dmahrt@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

 Dec 16 2016 12:31 PM

Daniel B. Mahrt, PE  
Associate Principal – Principal Engineer



Mark L. Jenkins, PE  
Senior Engineer

## Table of Contents

Description	Page
A. Introduction.....	1
A.1. Project Description.....	1
A.2. Site Conditions and History .....	2
A.3. Purpose.....	2
A.4. Background Information and Reference Documents.....	3
A.5. Scope of Services.....	3
B. Results .....	4
B.1. Geologic Overview .....	4
B.2. Boring Results.....	4
B.3. Groundwater .....	5
B.4. Laboratory Test Results.....	6
C. Recommendations .....	7
C.1. Design and Construction Discussion .....	7
C.2. Site Grading and Subgrade Preparation.....	8
C.2.a. Building Subgrade Excavations.....	8
C.2.b. Excavation Oversizing.....	8
C.2.c. Excavated Slopes.....	9
C.2.d. Excavation Dewatering.....	9
C.2.e. Pavement and Exterior Slab Subgrade Preparation.....	9
C.2.f. Pavement Subgrade Proofroll .....	10
C.2.g. Fill Materials and Compaction.....	10
C.2.h. Special Inspections of Soils.....	11
C.3. Spread Footings.....	12
C.4. Below-Grade Walls.....	12
C.4.a. Drainage Control .....	12
C.4.b. Configuring and Resisting Lateral Loads.....	14
C.5. Interior Slabs .....	15
C.5.a. Subgrade Modulus .....	15
C.5.b. Moisture Vapor Protection .....	15
C.6. Frost Protection.....	15
C.6.a. General.....	15
C.6.b. Frost Heave Mitigation.....	16
C.7. Pavements and Exterior Slabs .....	17
C.7.a. Design Sections .....	17
C.7.b. Concrete Pavements .....	18
C.7.c. Bituminous Pavement Materials.....	18
C.7.d. Subgrade Drainage .....	19
C.7.e. Performance and Maintenance .....	19
C.8. Utilities .....	19
C.8.a. Subgrade Stabilization.....	19
C.9. Equipment Support .....	20
D. Procedures.....	20
D.1. Penetration Test Borings.....	20
D.2. Exploration Logs .....	20
D.2.a. Log of Boring Sheets.....	20



## Table of Contents (continued)

Description	Page
D.2.b. Geologic Origins .....	21
D.3. Material Classification and Testing .....	21
D.3.a. Visual and Manual Classification .....	21
D.3.b. Laboratory Testing .....	21
D.4. Groundwater Measurements.....	21
E. Qualifications.....	22
E.1. Variations in Subsurface Conditions.....	22
E.1.a. Material Strata .....	22
E.1.b. Groundwater Levels .....	22
E.2. Continuity of Professional Responsibility.....	22
E.2.a. Plan Review .....	22
E.2.b. Construction Observations and Testing.....	23
E.3. Use of Report.....	23
E.4. Standard of Care.....	23

### Appendix

Soil Boring Location Sketch

Log of Boring Sheets ST-101 through ST-106, ST-6 and ST-7 (SP-13-00212)

Descriptive Terminology of Soil

## A. Introduction

### A.1. Project Description

This Geotechnical Evaluation Report addresses the proposed design and construction of Phase II of the Bottineau Ridge Apartments, located in the northwest corner of the intersection of Arbor Lakes Parkway and Hemlock Avenue in Maple Grove, Minnesota. Figure 1 in the Appendix shows the layout of the borings on the site. Tables 1 and 2 provide project details.

**Table 1. Building Description**

Aspect	Description
Below grade levels	One below-grade parking level
Above grade levels	4
Lowest level floor elevation	Approximately 901 (provided)
Maximum Column loads (kips)	250 (Assumed)
Maximum Wall loads (kips per linear foot)	8 (Assumed)
Nature of construction	Below-grade concrete or masonry, wood-framed above grade
Cuts or fills	Southern portion of site is near planned final grades. Northern portion of the site will require up to about 5 feet of fill.
Tolerable building settlement	1 inch total, 2/3-inch differential (Assumed)
Comments	Future expansion plans include adding to the east side of the Phase II structure. Borings for the future expansion were not included in this evaluation.

**Table 2. Site Aspects and Grading Description**

Aspect	Description
Assumed Pavement loads	Light-duty: 50,000 ESALs*
	Heavy-duty: 150,000 ESALs*
Grade changes	Less than 3 feet (Assumed)

\*Equivalent 18,000-lb single axle loads based on 20-year design.

## **A.2. Site Conditions and History**

The site is currently vacant, with sparse vegetation. Up to 8 inches of standing water was present in the central portion of the site when we completed the borings.

This area of Maple Grove has historically been mined for gravel. Braun Intertec has completed excavation observations and compaction testing supporting mine reclamation on this site and adjacent sites. Braun Intertec also completed a Geotechnical Evaluation Report for the Bottineau Ridge Phase I apartment building located south of the planned Phase II building (Braun Intertec Project SP-13-00212). As a part of the work on Bottineau Ridge Phase I, two soil borings were completed in the area of the Phase II development. Based on the results of those soil borings, and our previous work on this site, we anticipate that the northern portion of the site has not likely been mined, while the southern portion of the site may contain up to 15 feet of existing fill associated with mine reclamation.

Current grades within the building pad range from about 903 to 905 feet.

## **A.3. Purpose**

The purpose of our geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations and provide geotechnical recommendations for the design and construction of the new apartment facility.

#### **A.4. Background Information and Reference Documents**

We reviewed the following information:

- Site Plan dated April 27, 2016, prepared by Daniel K. Duffy Architects, Inc.
- Previous geotechnical report for Bottineau Phase I, prepared by Braun Intertec (project SP-13-00212) and dated March 6, 2013.
- “Summary Report” of excavation observations and compaction testing services at Seleen Pit, prepared by Braun Intertec (Project BN-04-03896), dated January 26, 2005.

In addition to the provided sources, we have used several publicly available sources of information.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

#### **A.5. Scope of Services**

We performed our scope of services for the project in accordance with our Proposal dated November 21, 2016. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Staking and clearing the exploration location of underground utilities. Duffy Development selected and we staked the new exploration locations. We acquired the surface elevations and locations with GPS technology using the State of Minnesota’s permanent GPS base station network. The Soil Boring Location Sketch included in the Appendix shows the approximate locations of the borings.
- Performing six standard penetration test (SPT) borings, denoted as ST-101 to ST-106, to nominal depths of 10 to 25 feet below grade across the site.
- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.

- Preparing this report containing a boring location sketch, logs of soil borings, a summary of the soils encountered, results of laboratory tests, and recommendations for structure and pavement subgrade preparation and the design of foundations, floor slabs, exterior slabs, utilities, stormwater improvements and pavements.

Our scope of services did not include environmental services or testing, and the personnel performing the evaluation are not trained to provide environmental services or testing. We can provide these services or testing at your request.

## B. Results

### B.1. Geologic Overview

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

### B.2. Boring Results

Table 3 provides a summary of the soil boring results, in the general order we encountered the strata. Please refer to the Log of Boring sheets in the Appendix for additional details. The Descriptive Terminology sheets in the Appendix include definitions of abbreviations used in Table 3.

**Table 3. Subsurface Profile Summary\***

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
Fill	SM, SC, SP-SM	11 to 44 BPF	<ul style="list-style-type: none"> <li>▪ Generally moist.</li> <li>▪ Thicknesses at boring locations varied from 4 to 12 feet.</li> </ul>
Glacial deposits	GP, GM, SP, SP-SM, SM	3 to over 50 BPF	<ul style="list-style-type: none"> <li>▪ General penetration resistance of 10 to 30 BPF.</li> </ul>

Strata	Soil Type - ASTM Classification	Range of Penetration Resistances	Commentary and Details
	SC	8 to 18 BPF	<ul style="list-style-type: none"> <li>▪ Variable amounts of gravel; may contain cobbles and boulders.</li> <li>▪ Moist to waterbearing</li> </ul>

\*Abbreviations defined in the attached Descriptive Terminology sheets.

Based on our review of previous geotechnical and construction materials testing information, it appears that the southern portion of the site was mined for gravel. The fill present in the northern portion of the site was likely placed during reclamation of the mine. Based on the blow counts and the types of soils identified as fill, the fill that was noted in the borings appeared to be placed in a controlled manner.

### B.3. Groundwater

Table 4 summarizes the depths where we observed groundwater; the attached Log of Boring sheets in the Appendix also include this information and additional details.

**Table 4. Groundwater Summary**

Location	Surface Elevation	Measured or Estimated Depth to Groundwater (ft)	Corresponding Groundwater Elevation (ft)
ST-101	903.5	17	886 ½
ST-102	903.6	16	888
ST-103	904.2	19	885 ½
ST-104	904.8	20	885

The soil borings indicate a layered soil profile that is conducive for encountering perched water conditions.

#### **B.4. Laboratory Test Results**

The boring logs show the results of laboratory testing we performed, next to the tested sample depth.

We performed moisture content (MC) tests (per ASTM D2216) on selected samples to aid in our classifications and estimations of the materials' engineering properties. The moisture content of the fill varied from approximately 3 to 10 percent, indicating that the material was dry of to near its probable optimum moisture content.

We performed tests to evaluate the percent of particles passing the #200 sieve (P200) (per ASTM D1140) to estimate the engineering properties of the granular material. The results of these tests indicated the soils encountered had P200s ranging from 6 to 36 percent. The tests indicated the samples classified as poorly-graded sand with silt (SP-SM) and clayey sand (SC), The Appendix includes graphical representations of the grain size analyses. The Log of Boring sheets list the results of P200 tests in the "Tests or Notes" column.

## **C. Recommendations**

### **C.1. Design and Construction Discussion**

Based on the results of our borings and our experiences on this site and adjacent sites, it is our opinion that the site is generally capable of accommodating the planned construction, supporting the building on conventional spread footings, with grade-supported slabs and bituminous pavements. As our records indicate portions of this site lie in an area that was not previously mined, we recommend that any existing fill encountered during construction be closely evaluated by a geotechnical engineer.

The near-surface subgrade soils typically consist of silty and clayey soils that are very susceptible to strength loss upon wetting, and disturbance from construction activities. Haul roads and staging areas will be particularly sensitive to disturbance and strength loss. Subexcavation and recompaction or replacement of the subgrade soils can be limited if the exposed grades are protected with imported crushed stone.

The existing, non-organic, debris-free, on-site soils are considered suitable for reuse as engineered fill below the proposed building pad. We do not recommend reusing existing fill that contains debris or organic material as structural fill.

In our judgment, the on-site soils are suitable for reuse as engineered fill, but will require moisture conditioning to achieve compaction. In the spring, and after periods of precipitation, the near-surface soils will likely be wet. To dry these soils, the contractor will need to perform extensive scarifying, which is easier to accomplish in the relatively drier months of June to September. If the contractor performs site grading in the spring or fall, on-site drying of these soils may not prove feasible and require importing drier soils. If time or space is not available to dry these soils, the contractor may need to import drier soils. We recommend discussing the reuse of these materials with potential contractors at the bidding stages of the project.

To account for potential rainfall during construction, we recommend maintaining construction grades to intercept surface water flow into the area and drain water from the area to an appropriate collection point. After grading, the contractor should compact the soil surface with a smooth drum roller to attempt to lower infiltration. After rain events, the contractor should limit construction traffic until the surface is dry enough that traffic will not mix accumulated surface water into lower portions of the soil.



## C.2. Site Grading and Subgrade Preparation

### C.2.a. Building Subgrade Excavations

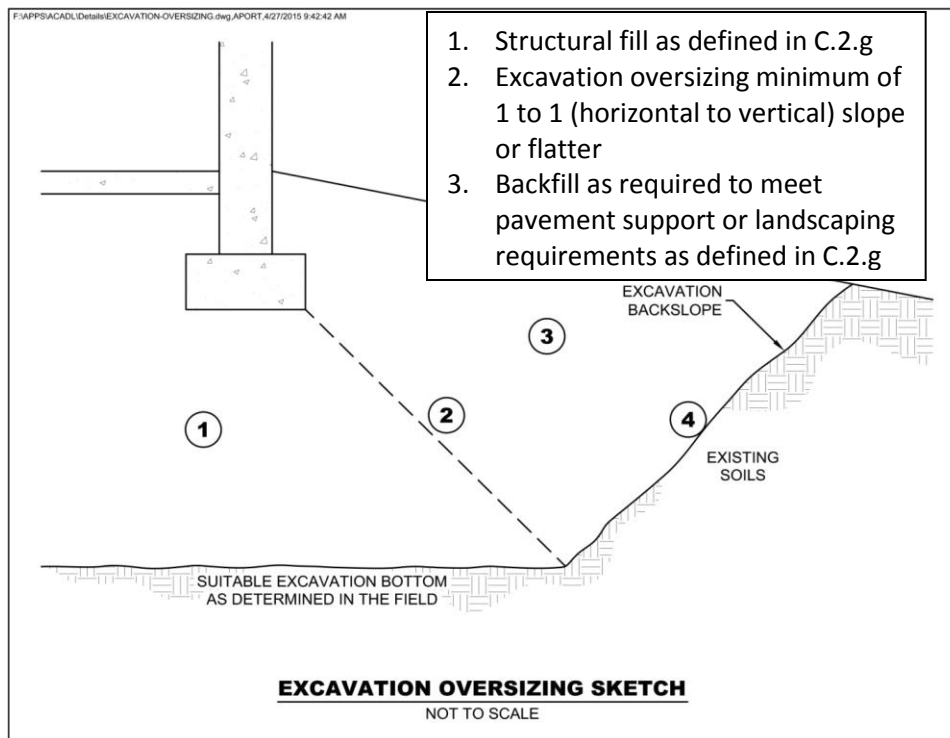
We recommend removing topsoil from below the proposed building and pavement areas. We anticipate the excavations will range from about 6 inches to 2 feet.

We anticipate excavations to reach the garage slab and foundation bearing elevations will terminate in fill. Once subgrade elevations are exposed, we recommend surface compacting the exposed fill with a vibratory smooth drum self-propelled roller with a minimum 42-inch diameter drum, capable of exerting a centrifugal force of at least 50,000 pounds. We recommend the surface compaction consist of a minimum of 6 passes of the compactor. Footing subgrade soils should be compacted with a large vibratory plate prior to placing formwork. The geotechnical engineer should observe the compaction efforts to determine if any areas are unstable and need further stabilization measures. Compaction testing should subsequently be performed to evaluate the compactive effort.

### C.2.b. Excavation Oversizing

When removing unsuitable materials below structures or pavements, we recommend the excavation extend outward and downward at a slope of 1H:1V (horizontal:vertical) or flatter. See Figure 1 for an illustration of excavation oversizing.

Figure 1. Generalized Illustration of Oversizing



### **C.2.c. Excavated Slopes**

Based on the borings, we anticipate on-site soils in excavations will consist of mixed soils. These soils are typically considered Type C Soil under OSHA (Occupational Safety and Health Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type C soils should have a gradient no steeper than 1 1/2H:1V. Slopes constructed in this manner may still exhibit surface sloughing. OSHA requires an engineer to evaluate slopes or excavations over 20 feet in depth.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches." This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

### **C.2.d. Excavation Dewatering**

We recommend removing groundwater from the excavations. Project planning should include temporary sumps and pumps for excavations in low-permeability soils, such as clays. Dewatering of high-permeability soils (e.g., sands) from within the excavation with conventional pumps has the potential to loosen the soils, due to upward flow. A well contractor should develop a dewatering plan; the design team should review this plan.

### **C.2.e. Pavement and Exterior Slab Subgrade Preparation**

We recommend the following steps for pavement and exterior slab subgrade preparation, understanding the site will have a grade change of 5 feet or less. Note that project planning may need to require additional subcuts to limit frost heave.

1. Strip unsuitable soils consisting of topsoil, organic soils, peat, vegetation, existing structures and pavements from the area, within 3 feet of the surface of the proposed pavement grade.
2. Have a geotechnical representative observe the excavated subgrade to evaluate if additional subgrade improvements are necessary.
3. Slope subgrade soils to areas of sand or drain tile where accumulating water can be removed.
4. Scarify, moisture condition and surface compact the subgrade with at least 6 passes of a large roller with a minimum drum diameter of 3 ½ feet.

5. Place pavement fill to grade and compact in accordance with Section C.2.g to bottom of pavement and exterior slab section. See Section C.6 for additional considerations related to frost heave.
6. Proofroll the pavement or exterior slab subgrade as described in Section C.2.f.

### C.2.f. Pavement Subgrade Proofroll

After preparing the subgrade as described above and prior to the placement of the aggregate base, we recommend proofrolling the subgrade soils with a fully loaded tandem-axle truck. We also recommend having a geotechnical representative observe the proofroll. Areas that fail the proofroll likely indicate soft or weak areas that will require additional soil correction work to support pavements.

The contractor should correct areas that display excessive yielding or rutting during the proofroll, as determined by the geotechnical representative. Possible options for subgrade correction include moisture conditioning and recompaction, subcutting and replacement with soil or crushed aggregate, chemical stabilization and/or geotextiles. We recommend performing a second proofroll after the aggregate base material is in place, and prior to placing bituminous or concrete pavement.

### C.2.g. Fill Materials and Compaction

Table 5 below contains our recommendations for fill materials.

**Table 5. Fill Materials\***

Locations To Be Used	Fill Classification	Possible Soil Type Descriptions	Gradation	Additional Requirements
<ul style="list-style-type: none"> <li>▪ Below foundations</li> <li>▪ Below interior slabs</li> </ul>	Structural fill	SP, SW, SP-SM, SW-SM, SM, SC	100% passing 2-inch sieve	< 2% Organic Content (OC)
<ul style="list-style-type: none"> <li>▪ Drainage layer</li> <li>▪ Non-frost-susceptible</li> </ul>	<ul style="list-style-type: none"> <li>▪ Free-draining</li> <li>▪ Non-frost-susceptible fill</li> </ul>	GP, GW, SP, SW	100% passing 1-inch sieve < 50% passing #40 sieve < 5% passing #200 sieve	< 2% OC
Behind below-grade walls, beyond drainage layer	Retained fill	SP, SW, SP-SM, SW-SM, SM	100% passing 3-inch sieve < 20% passing #200 sieve	< 2% OC Plasticity Index (PI) < 4%
Pavements	Pavement fill	SP, SW, SP-SM, SW-SM, SM, SC	100% passing 3-inch sieve	< 2% OC PI < 15%
Below landscaped surfaces, where subsidence is not a concern	Non-structural fill	any	100% passing 6-inch sieve	< 10% OC

\* Fill materials should satisfy applicable environmental requirements.

\* More select soils comprised of coarse sands with < 5% passing #200 sieve may be needed to accommodate work occurring in periods of wet or freezing weather.

We recommend spreading fill in loose lifts of approximately 8 to 10 inches thick. We recommend compacting fill in accordance with the criteria presented below in Table 6. The project documents should specify relative compaction of fill, based on the structure located above the fill, and vertical proximity to that structure.

**Table 6. Compaction Recommendations Summary**

Reference	Relative Compaction, percent (ASTM D698 – Standard Proctor)	Moisture Content Variance from Optimum, percentage points	
		< 12% Passing #200 Sieve (typically SP, SP-SM)	> 12% Passing #200 Sieve (typically CL, SC, ML, SM)
Below foundations, slabs and oversizing zones	98	±3	-1 to +3
Within 3 feet of pavement subgrade	100	±3	-1 to +3
More than 3 feet below pavement subgrade	95	±3	±3
Below landscaped surfaces	90	±5	±4
Adjacent to below-grade wall	95*	±3	-1 to +3

\*Increase compaction requirement to meet compaction required for structure supported by this fill.

The project documents should not allow the contractor to use frozen material as fill or to place fill on frozen material. Frost should not penetrate under foundations during construction.

We recommend performing density tests in fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

**C.2.h. Special Inspections of Soils**

We recommend including the site grading and placement of fill within the building pad under the direction of Special Inspections, as provided in Chapter 17 of the International Building Code, which is adopted into the state building code. Special Inspection requires observation of soil conditions below fill or footings, evaluations to determine if excavations extend to the anticipated soils, and if fill materials meet requirements for type of fill and compaction condition of fill. A licensed geotechnical engineer should direct the Special Inspections of site grading and fill placement.

The purpose of these Special Inspections is to evaluate whether the work is in accordance with the approved Geotechnical Report for the project. Special Inspections should include evaluation of the subgrade, observing preparation of the subgrade (surface compaction or dewatering, excavation oversizing, placement procedures and materials used for fill, etc.) and compaction testing of the fill.

### C.3. Spread Footings

Table 7 below contains our recommended parameters for foundation design.

**Table 7. Recommended Spread Footing Design Parameters**

Item	Description
Maximum net allowable bearing pressure (psf)	3,000
Minimum factor of safety for bearing capacity failure	3.0
Minimum width (inches)	18
Minimum embedment below final exterior grade for heated structures (inches)	42
Minimum embedment below final exterior grade for unheated structures or for footings not protected from freezing temperatures during construction (inches)	60
Total estimated settlement (inches)	1
Differential settlement	Typically about 1/2 of total settlement*

\* Actual differential settlement amounts will depend on final loads and foundation layout.

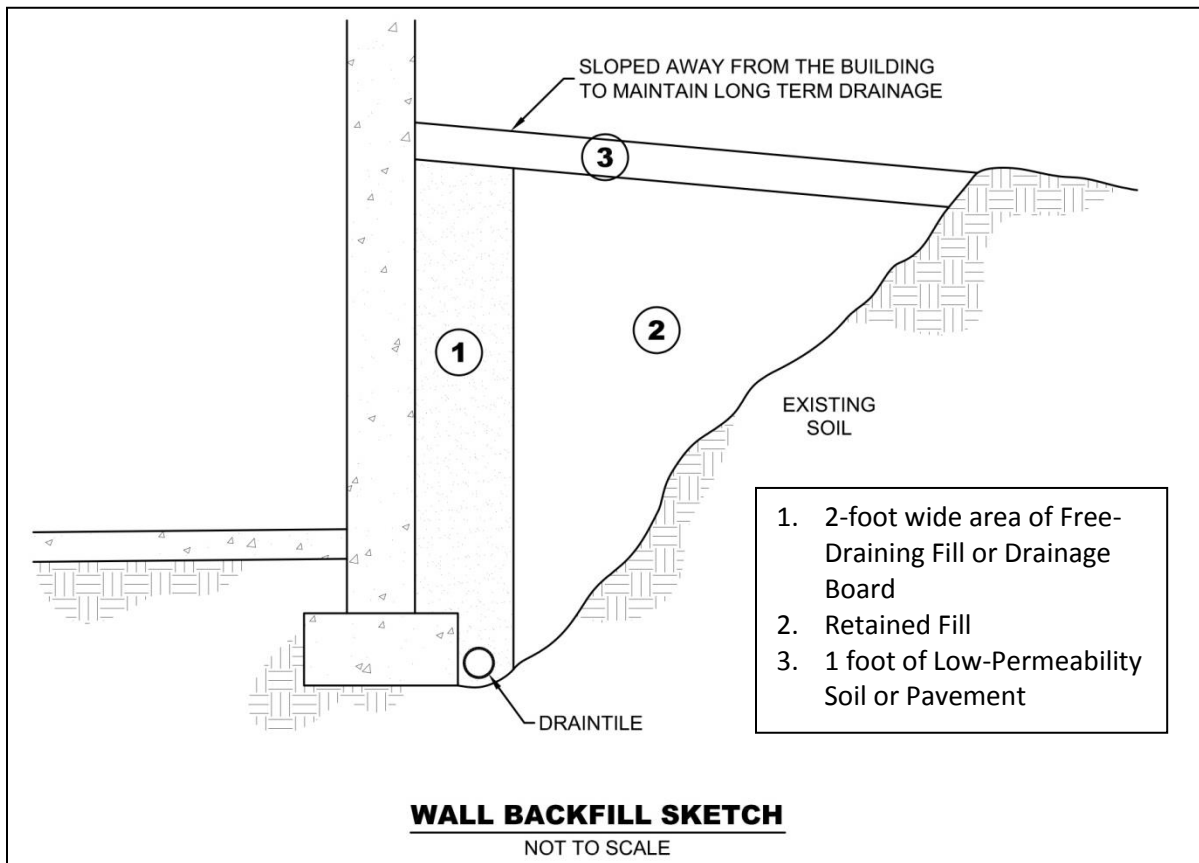
### C.4. Below-Grade Walls

#### C.4.a. Drainage Control

We recommend installing drain tile to remove water behind the below-grade walls, at the location shown in Figure 2. The below-grade wall drainage system should also incorporate free-draining fill or a drainage board placed against the wall and connected to the drain tile.

Even with the use of free-draining fill, we recommend general waterproofing of below-grade walls that surround occupied or potentially occupied areas because of the potential cost impacts related to seepage after construction is complete.

**Figure 2. Generalized Illustration of Wall Backfill**



The materials listed in the sketch should meet the definitions in Section C.2.g. Low-permeability material is capable of directing water away from the wall, like clay, topsoil or pavement. The project documents should indicate if the contractor should brace the walls prior to filling and allowable unbalanced fill heights.

As shown in Figure 2, we recommend Zone 2 consist of retained fill, and this material will control lateral pressures on the wall. However, we are also providing design parameters for using other fill material. If final design uses non-sand material for fill, project planning should account for the following items:

- Other fill material may result in higher lateral pressure on the wall.
- Other fill material may be more difficult to compact.

- Post-construction consolidation of other fill material may result in settlement-related damage to the structures or slabs supported on the fill. Post-construction settlement of other fill material may also cause drainage towards the structure. The magnitude of consolidation could be up to about 3 percent of the wall fill thickness.

**C.4.b. Configuring and Resisting Lateral Loads**

Below-grade wall design can use active earth pressure conditions, if the walls can rotate slightly. If the wall design cannot tolerate rotation, then design should use at-rest earth pressure conditions. Rotation up to 0.002 times the wall height is generally required for walls supporting sand.

Table 8 presents our recommended lateral coefficients and equivalent fluid pressures for wall design of active, at-rest and passive earth pressure conditions. The table also provides recommended wet unit weights and internal friction angles. Designs should also consider the slope of any fill and dead or live loads placed behind the walls within a horizontal distance that is equal to the height of the walls. Our recommended values assume the wall design provides drainage so water cannot accumulate behind the walls. The construction documents should clearly identify what soils the contractor should use for the fill of walls.

**Table 8. Recommended Below-Grade Wall Design Parameters – Drained Conditions**

Retained Soil	Wet Unit Weight, pcf	Friction Angle, degrees	Active Lateral Coefficient/ Equivalent Fluid Pressure* (pcf)	At-Rest Lateral Coefficient/ Equivalent Fluid Pressure* (pcf)	Passive Lateral Coefficient/ Equivalent Fluid Pressure* (pcf)
SP, SP-SM	120	32	0.31/37	0.47/56	3.25/391
SM, SC	120	28	0.36/43	0.53/64	2.77/332

\* Based on Rankine model for soils in a region behind the wall extending at least 2 horizontal feet beyond the bottom outer edges of the wall footings and then rising up and away from the wall at an angle no steeper than 60 degrees from horizontal.

Sliding resistance between the bottom of the footing and the soil can also resist lateral pressures. We recommend assuming a sliding coefficient equal to 0.33 between the concrete and soil.

The values presented in this section are un-factored.

## **C.5. Interior Slabs**

### **C.5.a. Subgrade Modulus**

The anticipated floor subgrade is fill consisting of silty and clayey sands. We recommend using a modulus of subgrade reaction,  $k$ , of 150 pounds per square inch per inch of deflection (pci) to design the slabs. If the slab design requires placing 6 inches of compacted crushed aggregate base immediately below the slab, the slab design may increase the  $k$ -value by 50 pci. We recommend that the aggregate base materials be free of bituminous. In addition to improving the modulus of subgrade reaction, an aggregate base facilitates construction activities and is less weather sensitive.

### **C.5.b. Moisture Vapor Protection**

Excess transmission of water vapor could cause floor dampness, certain types of floor bonding agents to separate, or mold to form under floor coverings. If project planning includes using floor coverings or coatings, we recommend placing a vapor retarder or vapor barrier immediately beneath the slab. We also recommend consulting with floor covering manufacturers regarding the appropriate type, use and installation of the vapor retarder or barrier to preserve warranty assurances.

## **C.6. Frost Protection**

### **C.6.a. General**

Silty and clayey sands will underlie all or some of the exterior slabs, as well as pavements. We consider silty and clayey sands to be moderately to highly frost susceptible. Soils of this type can retain moisture and heave upon freezing. In general, this characteristic is not an issue unless these soils become saturated, due to surface runoff or infiltration, or are excessively wet in situ. Once frozen, unfavorable amounts of general and isolated heaving of the soils and the surface structures supported on them could develop. This type of heaving could affect design drainage patterns and the performance of exterior slabs and pavements, as well as any isolated exterior footings and piers.

Note that general runoff and infiltration from precipitation are not the only sources of water that can saturate subgrade soils and contribute to frost heave. Roof drainage and irrigation of landscaped areas in close proximity to exterior slabs, pavements, and isolated footings and piers, contribute as well.



### **C.6.b. Frost Heave Mitigation**

To address most of the heave related issues, we recommend setting general site grades and grades for exterior surface features to direct surface drainage away from buildings, across large paved areas and away from walkways. Such grading will limit the potential for saturation of the subgrade and subsequent heaving. General grades should also have enough “slope” to tolerate potential larger areas of heave, which may not fully settle after thawing.

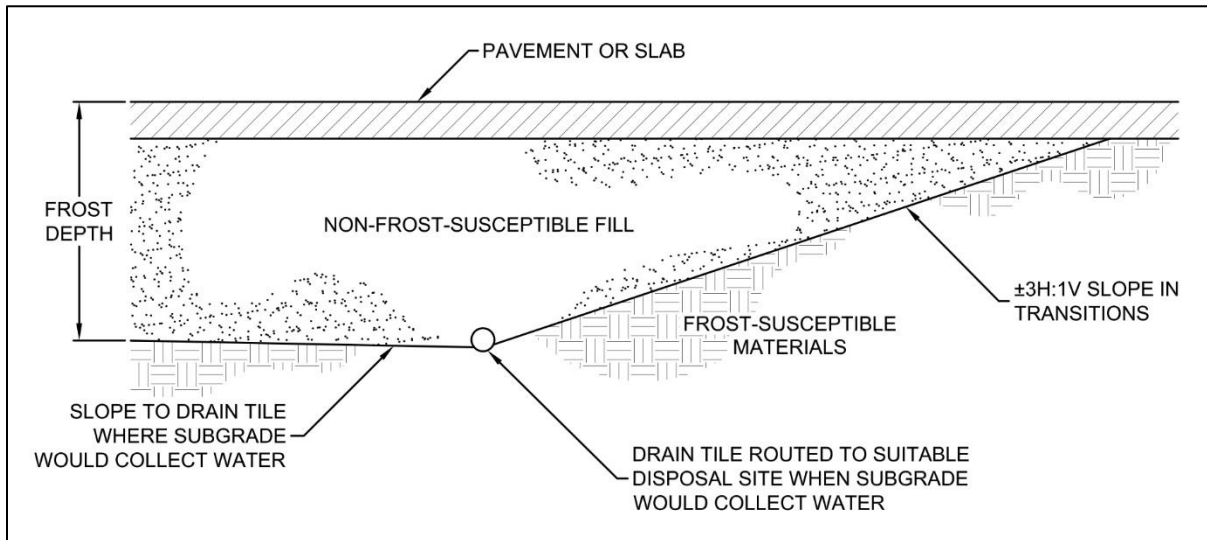
Even small amounts of frost-related differential movement at walkway joints or cracks can create tripping hazards. Project planning can explore several subgrade improvement options to address this condition.

One of the more conservative subgrade improvement options to mitigate potential heave is removing any frost-susceptible soils present below the exterior slab areas down to a minimum depth of 5 feet below subgrade elevations. We recommend filling the resulting excavation with non-frost-susceptible fill. We also recommend sloping the bottom of the excavation toward one or more collection points to remove any water entering the fill. This approach will not be effective in controlling frost heave without removing the water.

An important geometric aspect of the excavation and replacement approach described above is sloping the banks of the excavations to create a more gradual transition between the unexcavated soils considered frost susceptible and the excavation fill, which is not frost susceptible. The slope allows attenuation of differential movement that may occur along the excavation boundary. We recommend slopes that are 3H:1V, or flatter, along transitions between frost-susceptible and non-frost-susceptible soils.

Figure 3 shows an illustration summarizing some of the recommendations.

**Figure 3. Frost Protection Geometry Illustration**



Another option is to limit frost heave in critical areas, such as doorways and entrances, via frost-depth footings or localized excavations with sloped transitions between frost-susceptible and non-frost-susceptible soils, as described above.

Over the life of slabs and pavements, cracks will develop and joints will open up, which will expose the subgrade and allow water to enter from the surface and either saturate or perch atop the subgrade soils. This water intrusion increases the potential for frost heave or moisture-related distress near the crack or joint. Therefore, we recommend implementing a detailed maintenance program to seal and/or fill any cracks and joints. The maintenance program should give special attention to areas where dissimilar materials abut one another, where construction joints occur and where shrinkage cracks develop.

## C.7. Pavements and Exterior Slabs

### C.7.a. Design Sections

Our scope of services for this project did not include laboratory tests on subgrade soils to determine an R-value for pavement design. Based on our experience with similar soils anticipated at the pavement subgrade elevation, we recommend pavement design assume an R-value of 30. Note the contractor may need to perform limited removal of unsuitable or less suitable soils to achieve this value. Table 9 provides recommended pavement sections, based on the soils support and traffic loads.

**Table 9. Recommended Bituminous Pavement Sections**

Use	Light Duty	Heavy Duty
Minimum asphalt thickness (inches)	3 ½	4
Minimum concrete thickness (inches)	5	6
Minimum aggregate base thickness (inches)	8 (for bituminous pavement) 6 (for concrete pavement)	10 (for bituminous pavement) 6 (for concrete pavement)

**C.7.b. Concrete Pavements**

We assumed the concrete pavement sections in Table 9 will have edge support. We recommend placing an aggregate base below the pavement to provide a suitable subgrade for concrete placement, reduce faulting and help dissipate loads. Appropriate mix designs, panel sizing, jointing, doweling and edge reinforcement are critical to performance of rigid pavements. We recommend you contact your civil engineer to determine the final design or consult with us for guidance on these items.

**C.7.c. Bituminous Pavement Materials**

We recommend specifying crushed aggregate base meeting the requirements of Minnesota Department of Transportation (MnDOT) Specification 3138 for Class 5. We recommend that the bituminous wear and non-wear courses meet the requirements of Specifications 2360, with the following designations:

- Wear: SPWEA240B or SPWEB240B
- Non-wear: SPNWA230B or SPNWB230B

In the above mixes, aggregate A (as in SPWEA240B), a 1/2-inch maximum size, will provide a surface with less visible aggregate than B (3/4-inch maximum size).

We recommend asphalt grade B (as in SPWEA240B), or 58-28. Additional resistance to rutting, scuffing and dimpling can be obtained with a 64-28/E grade asphalt. A PG 58-34/C asphalt grade will provide additional resistance to cold-weather cracking.

We recommend compacting the aggregate base to meet the requirements of MnDOT Specification 2211.3.D.2.c (Penetration Index Method for the dynamic cone penetrometer (DCP)). We recommend compacting bituminous pavements to at least 92 percent of their maximum theoretical (Rice) density.

We recommend specifying concrete for pavements that has a minimum 28-day compressive strength of 4,000 psi, and a modulus of rupture ( $M_r$ ) of at least 600 psi. We also recommend Type I cement meeting the requirements of ASTM C 150. We recommend specifying 5 to 7 percent entrained air for exposed concrete to provide resistance to freeze-thaw deterioration, and a water/cement ratio of 0.45 or less for concrete exposed to deicers.

#### **C.7.d. Subgrade Drainage**

We recommend installing perforated drainpipes throughout pavement areas at low points, around catch basins, and behind curb in landscaped areas. We also recommend installing drainpipes along pavement and exterior slab edges where exterior grades promote drainage toward those edge areas. The contractor should place drainpipes in small trenches, extended at least 8 inches below the granular subbase layer, or below the aggregate base material where no subbase is present.

#### **C.7.e. Performance and Maintenance**

We based the above pavement designs on a 20-year performance life for bituminous and a 35-year life for concrete. This is the amount of time before we anticipate the pavement will require reconstruction. This performance life assumes routine maintenance, such as seal coating and crack sealing. The actual pavement life will vary depending on variations in weather, traffic conditions and maintenance.

It is common to place the non-wear course of bituminous and then delay placement of wear course. For this situation, we recommend evaluating if the reduced pavement section will have sufficient structure to support construction traffic.

Many conditions affect the overall performance of the exterior slabs and pavements. Some of these conditions include the environment, loading conditions and the level of ongoing maintenance. With regard to bituminous pavements in particular, it is common to have thermal cracking develop within the first few years of placement, and continue throughout the life of the pavement. We recommend developing a regular maintenance plan for filling cracks in exterior slabs and pavements to lessen the potential impacts for cold weather distress due to frost heave or warm weather distress due to wetting and softening of the subgrade.

### **C.8. Utilities**

#### **C.8.a. Subgrade Stabilization**

Earthwork activities associated with utility installations located inside the building footprint should adhere to the recommendations in Section C.2.

For exterior utilities, we anticipate the soils at typical invert elevations will be suitable for utility support. However, if construction encounters unfavorable conditions such as soft clay, organic soils or perched water at invert grades, the unsuitable soils may require some additional subcutting and replacement with sand or crushed rock to prepare a proper subgrade for pipe support. Project design and construction should not place utilities within the 1H:1V oversizing of foundations.

## **C.9. Equipment Support**

The recommendations included in the report may not be applicable to equipment used for the construction and maintenance of this project. We recommend evaluating subgrade conditions in areas of shoring, scaffolding, cranes, pumps, lifts and other construction equipment prior to mobilization to determine if the exposed materials are suitable for equipment support, or require some form of subgrade improvement. We also recommend project planning consider the effect that loads applied by such equipment may have on structures they bear on or surcharge – including pavements, buried utilities, below-grade walls, etc. We can assist you in this evaluation.

## **D. Procedures**

### **D.1. Penetration Test Borings**

We drilled the penetration test borings with an ATV-mounted core and auger drill equipped with hollow-stem auger. We performed the borings in general accordance with ASTM D1586 taking penetration test samples at 2 1/2- or 5-foot intervals. We collected thin-walled tube samples in general accordance with ASTM D1587 at selected depths. The boring logs show the actual sample intervals and corresponding depths. We also collected bulk samples of auger cuttings at selected locations for laboratory testing.

### **D.2. Exploration Logs**

#### **D.2.a. Log of Boring Sheets**

The Appendix includes Log of Boring sheets for our penetration test borings. The logs identify and describe the penetrated geologic materials, and present the results of penetration resistance and other in-situ tests performed. The logs also present the results of laboratory tests performed on penetration test samples, and groundwater measurements.

We inferred strata boundaries from changes in the penetration test samples and the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

### **D.2.b. Geologic Origins**

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance testing performed for the project, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

## **D.3. Material Classification and Testing**

### **D.3.a. Visual and Manual Classification**

We visually and manually classified the geologic materials encountered in accordance with ASTM D2488. The Appendix includes a chart explaining the classification system.

### **D.3.b. Laboratory Testing**

The exploration logs in the Appendix note most of the results of the laboratory tests performed on geologic material samples. The remaining laboratory test results follow the exploration logs. We performed the tests in general accordance with ASTM or AASHTO procedures.

## **D.4. Groundwater Measurements**

The drillers checked for groundwater while advancing the penetration test borings, and again after auger withdrawal. We then filled the boreholes or allowed them to remain open for an extended period of observation, as noted on the boring logs.

## **E. Qualifications**

### **E.1. Variations in Subsurface Conditions**

#### **E.1.a. Material Strata**

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work, or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

#### **E.1.b. Groundwater Levels**

We made groundwater measurements under the conditions reported herein and shown on the exploration logs, and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

### **E.2. Continuity of Professional Responsibility**

#### **E.2.a. Plan Review**

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

### **E.2.b. Construction Observations and Testing**

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

### **E.3. Use of Report**

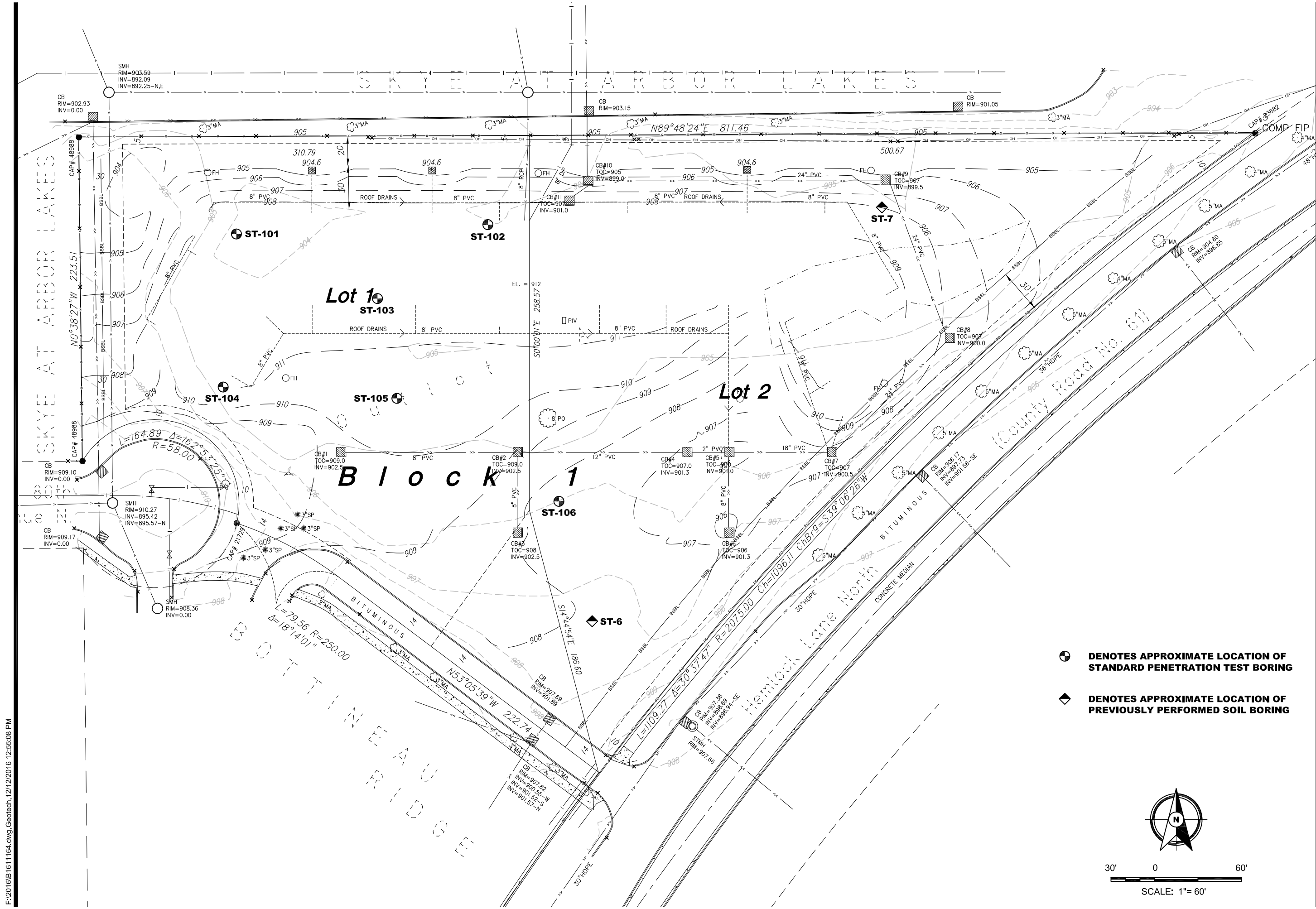
This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

### **E.4. Standard of Care**

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

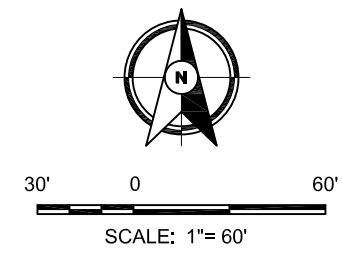


## Appendix



SOIL BORING LOCATION SKETCH  
 GEOTECHNICAL EVALUATION  
 BOTTINEAU RIDGE II  
 NORTHWEST QUADRANT OF ARBOR LAKES PARKWAY AND HEMLOCK AVENUE  
 MAPLE GROVE, MINNESOTA

- DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING
- DENOTES APPROXIMATE LOCATION OF PREVIOUSLY PERFORMED SOIL BORING



Project No:	B1611164
Drawing No:	B1611164
Scale:	1" = 60'
Drawn By:	JAG
Date Drawn:	11/25/16
Checked By:	DBM
Last Modified:	12/12/16

Sheet: \_\_\_\_\_ of \_\_\_\_\_ Fig: \_\_\_\_\_

(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\AX PROJECTS\2016\11164.GPJ BRAUN\_V8\_CURRENT.GDT 12/16/16 11:32

Braun Project B1611164 GEOTECHNICAL EVALUATION REPORT Bottineau Ridge II NWQ of Arbor Lakes Parkway & Hemlock Avenue Maple Grove, Minnesota					BORING: <b>ST-101</b> LOCATION: See attached sketch.				
DRILLER: M. Nolden		METHOD: 3 1/4" HSA, Autohammer			DATE: 12/2/16		SCALE: 1" = 4'		
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	P200 %	Tests or Notes	
903.5	0.0								
903.0	0.5	FILL	FILL: Silty Sand, fine-grained, dark brown, moist. (Topsoil)						
		FILL	FILL: Poorly Graded Sand with Silt, brown, moist.						
899.5	4.0			11		3	6		
		FILL	FILL: Silty Sand, medium-grained, trace Gravel, brown, moist.						
				16					
				44					
				33					
891.5	12.0	GP	POORLY GRADED GRAVEL, coarse-grained, brown, wet to waterbearing, medium dense to dense. (Glacial Outwash)						
				33					
				26					
					▽				An open triangle in the water level (WL) column indicates the depth at which groundwater was observed while drilling.
				44					
877.5	26.0			38					
			END OF BORING.  Groundwater observed at 17 feet while drilling.  Boring then backfilled with cuttings.						

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B1611164 GEOTECHNICAL EVALUATION REPORT Bottineau Ridge II NWQ of Arbor Lakes Parkway & Hemlock Avenue Maple Grove, Minnesota					BORING: <b>ST-102</b> LOCATION: See attached sketch.				
DRILLER: M. Nolden		METHOD: 3 1/4" HSA, Autohammer			DATE: 12/2/16		SCALE: 1" = 4'		
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	P200 %	Tests or Notes	
903.6	0.0								
903.1	0.5	FILL	FILL: Silty Sand, fine-grained, dark brown, moist. (Topsoil)						
		FILL	FILL: Clayey Sand, brown, moist.	28		9	36		
				19					
896.6	7.0	SP-SM	POORLY GRADED SAND with SILT, Poorly Graded Sand with Silt, medium-grained, trace Gravel, brown, moist, medium dense. (Glacial Outwash)	26					
				19					
892.6	11.0	SP-SM	POORLY GRADED SAND with SILT, coarse-grained, trace Gravel, moist to waterbearing, medium. (Glacial Outwash)	16					
				17					
					▽				
				13					
880.6	23.0	GP	POORLY GRADED GRAVEL, coarse-grained, brown, waterbearing, medium dense. (Glacial Outwash)	20					
877.6	26.0		END OF BORING.						
			Groundwater observed at 16 feet while drilling.						
			Boring then backfilled with cuttings.						

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(See Descriptive Terminology sheet for explanation of abbreviations)

Braun Project B1611164 GEOTECHNICAL EVALUATION REPORT Bottineau Ridge II NWQ of Arbor Lakes Parkway & Hemlock Avenue Maple Grove, Minnesota					BORING: <b>ST-103</b> LOCATION: See attached sketch.				
DRILLER: M. Nolden		METHOD: 3 1/4" HSA, Autohammer			DATE: 12/2/16		SCALE: 1" = 4'		
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	P200 %	Tests or Notes	
904.2	0.0								
903.9	0.3	FILL	FILL: Silty Sand, fine-grained, dark brown, moist. (Topsoil)						
		FILL	FILL: Clayey Sand, brown, moist.						
				20		10	33		
				24					
897.2	7.0	SC	CLAYEY SAND, with Gravel, brown, moist, loose to medium dense. (Glacial Outwash)						
				8					
				18					
892.2	12.0	SM	SILTY SAND, fine-grained, gray, wet, very loose. (Glacial Outwash)						
				3					
890.2	14.0	GM	SILTY GRAVEL, coarse-grained, brown, wet to waterbearing, loose to dense. (Glacial Outwash)						
				9					
					▽				
				12					
				44					
878.2	26.0		END OF BORING.						
			Groundwater at 19 feet while drilling.						
			Boring then backfilled with cuttings.						

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B1611164</b> <b>GEOTECHNICAL EVALUATION REPORT</b> <b>Bottineau Ridge II</b> <b>NWQ of Arbor Lakes Parkway &amp; Hemlock Avenue</b> <b>Maple Grove, Minnesota</b>					BORING: <b>ST-104</b> LOCATION: See attached sketch.				
DRILLER: M. Nolden		METHOD: 3 1/4" HSA, Autohammer			DATE: 12/2/16		SCALE: 1" = 4'		
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	P200 %	Tests or Notes	
904.8	0.0								
902.8	2.0	FILL	FILL: Poorly Graded Sand with Silt, medium-grained, brown, moist. (Topsoil)						
		FILL	FILL: Poorly Graded Sand with Silt, medium-grained, brown, moist.	20		8	11		
				17					
897.8	7.0	SM	SILTY SAND, coarse-grained, with Gravel, brown, moist, dense. (Glacial Outwash)	50/3"					
				50/4"					
				88					
				43					
886.8	18.0	GP	POORLY GRADED GRAVEL, coarse-grained, brown, waterbearing, medium dense to dense. (Glacial Outwash)						
				28	▽				
				35					
878.8	26.0		END OF BORING.						
			Groundwater observed at 20 feet while drilling.						
			Boring then backfilled with cuttings.						

(See Descriptive Terminology sheet for explanation of abbreviations)

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Braun Project B1611164 GEOTECHNICAL EVALUATION REPORT Bottineau Ridge II NWQ of Arbor Lakes Parkway & Hemlock Avenue Maple Grove, Minnesota					BORING: <b>ST-105</b>				
DRILLER: M. Nolden			METHOD: 3 1/4" HSA, Autohammer		DATE: <b>12/2/16</b>		SCALE: <b>1" = 4'</b>		
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	P200 %	Tests or Notes	
904.9	0.0	FILL	FILL: Silty Sand, fine- to medium-grained, dark brown, moist. (Topsoil)						
904.6	0.3	FILL	FILL: Clayey Sand, trace Gravel, brown, moist.						
900.9	4.0	SM	SILTY SAND, medium-grained, brown, moist, medium dense. (Glacial Outwash)	17		10	33		
897.9	7.0	SP	POORLY GRADED SAND, fine- to medium-grained, brown, moist, loose to medium dense. (Glacial Outwash)	25					
893.9	11.0		END OF BORING.  Groundwater not observed while drilling.  Boring then backfilled with cuttings.	7					

(See Descriptive Terminology sheet for explanation of abbreviations)

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<b>Braun Project B1611164</b> <b>GEOTECHNICAL EVALUATION REPORT</b> <b>Bottineau Ridge II</b> <b>NWQ of Arbor Lakes Parkway &amp; Hemlock Avenue</b> <b>Maple Grove, Minnesota</b>					BORING: <b>ST-106</b> LOCATION: See attached sketch.				
DRILLER: M. Nolden		METHOD: 3 1/4" HSA, Autohammer			DATE: 12/2/16		SCALE: 1" = 4'		
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	MC %	P200 %	Tests or Notes	
905.8	0.0								
905.5	0.3	FILL	FILL: Silty Sand, fine-grained, dark brown, moist. (Topsoil)						
		FILL	FILL: Clayey Sand, brown, moist.						
901.8	4.0	SM	SILTY SAND, medium-grained, brown, moist, medium dense. (Glacial Outwash)	19		9	28		
				22					
				20					
894.8	11.0			24					
			END OF BORING.						
			Groundwater not observed while drilling.						
			Boring immediately backfilled with cuttings.						



(See Descriptive Terminology sheet for explanation of abbreviations)

LOG OF BORING N:\GINT\PROJECTS\STPAUL\2013\00212.GPJ BRAUN\_V8\_CURRENT.GDT 12/16/16 11:49

Braun Project SP-13-00212 Geotechnical Evaluation Hemlock Apartment Building NW of Arbor Lakes Parkway & Hemlock Avenue Maple Grove, Minnesota				BORING: <b>ST-6</b>		
				LOCATION: See attached sketch.		
DRILLER: J. Chermak		METHOD: 3 1/4" HSA, Autohammer		DATE: 1/28/13	SCALE: 1" = 4'	
Elev. feet	Depth feet	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
907.4	0.0					
906.8	0.6	FILL	FILL: Silty Sand, trace of roots, dark brown, moist.			Frozen to 4 feet.
		FILL	FILL: Silty Sand, fine- to medium-grained, trace of Gravel, reddish-brown, moist.			
904.4	3.0			30		
		FILL	FILL: Silty Sand, fine- to medium-grained, trace of Gravel, mixed and layered dark brown and brown with reddish-brown, moist.	10		
				29		
				28		
				26		
893.4	14.0	SP	POORLY GRADED SAND, fine- to medium-grained, trace of Gravel, brown, moist, medium dense to dense. (Glacial Outwash)	*		*50 blows for 4"
886.4	21.0			25		
			END OF BORING.  Water not observed while drilling.  Water not observed to cave-in depth of 12 feet immediately after withdrawal of auger.  Boring then backfilled.			

(See Descriptive Terminology sheet for explanation of abbreviations)

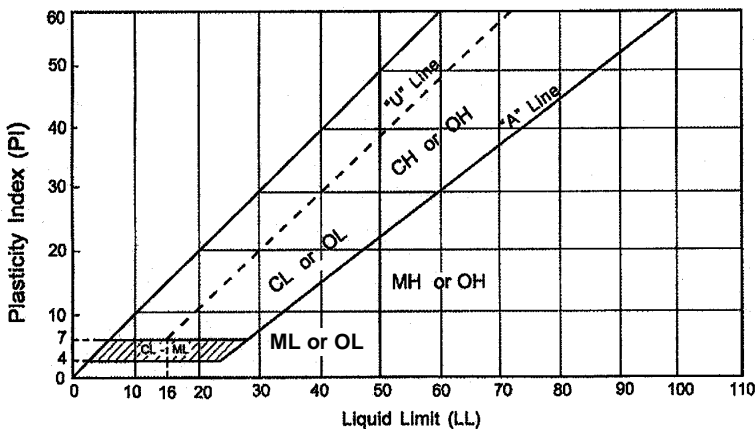
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<b>Braun Project SP-13-00212</b> <b>Geotechnical Evaluation</b> <b>Hemlock Apartment Building</b> <b>NW of Arbor Lakes Parkway &amp; Hemlock Avenue</b> <b>Maple Grove, Minnesota</b>				<b>BORING: ST-7</b> LOCATION: See attached sketch.		
DRILLER: J. Chermak		METHOD: 3 1/4" HSA, Autohammer		DATE: 1/28/13	SCALE: 1" = 4'	
Elev. feet 905.1	Depth feet 0.0	Symbol	Description of Materials (Soil-ASTM D2488 or D2487, Rock-USACE EM1110-1-2908)	BPF	WL	Tests or Notes
904.6	0.5	FILL	FILL: Silty Sand, trace of roots, dark brown, moist.			Frozen to 4 feet.
		FILL	FILL: Silty Sand, fine- to medium-grained, trace of Gravel, dark brown, moist.			
901.1	4.0	SM	SILTY SAND, trace of Gravel, reddish-brown, moist, medium dense to dense. (Glacial Till)	21		* *50 blows for 1" (set)
				30		
				23		
893.1	12.0	SP	POORLY GRADED SAND, fine- to medium-grained, trace of Gravel, reddish-brown, moist, dense. (Glacial Outwash)	46		
890.5	14.6		END OF BORING.  Water not observed while drilling.  Water not observed to cave-in depth of 12 feet immediately after withdrawal of auger.  Boring then backfilled.	*		*50 blows for 1" (set) suspected boulder or cobbles



Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>a</sup>				Soils Classification		
				Group Symbol	Group Name <sup>b</sup>	
Coarse-grained Soils more than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines <sup>e</sup>	$C_u \geq 4$ and $1 \leq C_c \leq 3$ <sup>c</sup>	GW	Well-graded gravel <sup>d</sup>	
		Gravels with Fines More than 12% fines <sup>e</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>d f g</sup>	
			Fines classify as CL or CH	GC	Clayey gravel <sup>d f g</sup>	
		Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines <sup>i</sup>	$C_u \geq 6$ and $1 \leq C_c \leq 3$ <sup>c</sup>	SW	Well-graded sand <sup>h</sup>
	Sands with Fines More than 12% <sup>i</sup>		Fines classify as ML or MH	SM	Silty sand <sup>f g h</sup>	
			Fines classify as CL or CH	SC	Clayey sand <sup>f g h</sup>	
	Fine-grained Soils 50% or more passed the No. 200 sieve		Silt and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line <sup>j</sup>	CL
		Organic		PI < 4 or plots below "A" line <sup>j</sup>	ML	Silt <sup>k l m</sup>
Liquid limit - oven dried < 0.75				OL	Organic clay <sup>k l m n</sup>	
Liquid limit - not dried < 0.75		OL		Organic silt <sup>k l m o</sup>		
Silt and clays Liquid limit 50 or more		Inorganic	PI plots on or above "A" line	CH	Fat clay <sup>k l m</sup>	
			PI plots below "A" line	MH	Elastic silt <sup>k l m</sup>	
		Organic	Liquid limit - oven dried < 0.75	OH	Organic clay <sup>k l m p</sup>	
			Liquid limit - not dried < 0.75	OH	Organic silt <sup>k l m q</sup>	
		Highly Organic Soils		Primarily organic matter, dark in color and organic odor	PT	Peat

- Based on the material passing the 3-inch (75mm) sieve.
- If field sample contained cobbles or boulders, or both, add "with cobbles or boulders or both" to group name.
- $C_u = D_{60}/D_{10}$   $C_c = (D_{30})^2 / (D_{10} \times D_{60})$
- If soil contains  $\geq 15\%$  sand, add "with sand" to group name.
- Gravels with 5 to 12% fines require dual symbols:  
GW-GM well-graded gravel with silt  
GW-GC well-graded gravel with clay  
GP-GM poorly graded gravel with silt  
GP-GC poorly graded gravel with clay
- If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
- If fines are organic, add "with organic fines" to group name.
- If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.
- Sand with 5 to 12% fines require dual symbols:  
SW-SM well-graded sand with silt  
SW-SC well-graded sand with clay  
SP-SM poorly graded sand with silt  
SP-SC poorly graded sand with clay
- If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
- If soil contains 10 to 29% plus No. 200, add "with sand" or "with gravel" whichever is predominant.
- If soil contains  $\geq 30\%$  plus No. 200, predominantly sand, add "sandy" to group name.
- If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.
- $PI \geq 4$  and plots on or above "A" line.
- $PI < 4$  or plots below "A" line.
- PI plots on or above "A" lines.
- PI plots below "A" line.



**Laboratory Tests**

<b>DD</b> Dry density, pcf	<b>OC</b> Organic content, %
<b>WD</b> Wet density, pcf	<b>S</b> Percent of saturation, %
<b>MC</b> Natural moisture content, %	<b>SG</b> Specific gravity
<b>LL</b> Liquid limit, %	<b>C</b> Cohesion, psf
<b>PL</b> Plastic limits, %	<b>Ø</b> Angle of internal friction
<b>PI</b> Plasticity index, %	<b>qu</b> Unconfined compressive strength, psf
<b>P200</b> % passing 200 sieve	<b>qp</b> Pocket penetrometer strength, tsf

**Particle Size Identification**

Boulders.....	over 12"
Cobbles .....	3" to 12"
Gravel	
Coarse .....	3/4" to 3"
Fine.....	No. 4 to 3/4"
Sand	
Coarse .....	No. 4 to No. 10
Medium.....	No. 10 to No. 40
Fine.....	No. 40 to No. 200
Silt .....	<No. 200, PI < 4 or below "A" line
Clay .....	<No. 200, PI $\geq 4$ and on or about "A" line

**Relative Density of Cohesionless Soils**

Very Loose.....	0 to 4 BPF
Loose.....	5 to 10 BPF
Medium dense .....	11 to 30 BPF
Dense .....	31 to 50 BPF
Very dense.....	over 50 BPF

**Consistency of Cohesive Soils**

Very soft.....	0 to 1 BPF
Soft .....	2 to 3 BPF
Rather soft .....	4 to 5 BPF
Medium.....	6 to 8 BPF
Rather stiff .....	9 to 12 BPF
Stiff .....	13 to 16 BPF
Very stiff.....	17 to 30 BPF
Hard.....	over 30 BPF

**Drilling Notes**

Standard penetration test borings were advanced by 3 1/4" or 6 1/4" ID hollow-stem augers, unless noted otherwise. Jetting water was used to clean out auger prior to sampling only where indicated on logs. All samples were taken with the standard 2" OD split-tube samples, except where noted.

Power auger borings were advanced by 4" or 6" diameter continuous flight, solid-stem augers. Soil classifications and strata depths were inferred from disturbed samples augered to the surface, and are therefore, somewhat approximate.

Hand auger borings were advanced manually with a 1 1/2" or 3 1/4" diameter auger and were limited to the depth from which the auger could be manually withdrawn.

**BPF:** Numbers indicate blows per foot recorded in standard penetration test, also known as "N" value. The sampler was set 6" into undisturbed soil below the hollow-stem auger. Driving resistances were then counted for second and third 6" increments, and added to get BPF. Where they differed significantly, they are reported in the following form: 2/12 for the second and third 6" increments, respectively.

**WH:** WH indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

**WR:** WR indicates the sampler penetrated soil under weight of rods alone; hammer weight, and driving not required.

**TW:** TW indicates thin-walled (undisturbed) tube sample.

**Note:** All tests were run in general accordance with applicable ASTM standards.



# SECTION 00 4100 – BID FORM

To: Bottineau Ridge II Apartments

Date: December 14, 2017

Having examined all bidding requirements, general conditions, Specifications and Drawings Bottineau Ridge II Apartments; dated December 4, 2017, and addenda similarly entitled and numbered \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, as prepared by JLG Architects, and having visited the site and examined all conditions affecting the work, the undersigned agrees to furnish and pay for all labor, materials, and equipment for the following Construction Contract as required by the afore mentioned documents for the following proposals:

Stipulated Sum Base Bid for (Single Prime):

## GENERAL, CIVIL, MECHANICAL, & ELECTRICAL CONSTRUCTION

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

Proposed Substantial Completion Date: \_\_\_\_\_

The undersigned agrees to perform **Alternates** (if required by Contract Documents) as described in the Contract Documents for the following cost as a change to the Base Bid Stipulated Sum stated above.

<b>Alternate Number</b>	<b>Description</b>	<b>Amount</b>
<b>1</b>	<b>Condo Pack Heating and Cooling Units DEDUCT:</b> State the amount to be DEDUCTED from the Base Bid to provide all materials, labor & equipment required for Condo Pack heating and cooling units in lieu of ventilation, AC units and hot water heat systems, as indicated in the drawings and specifications.	_____
<b>2</b>	<b>Poured in Place Concrete Foundations ADD:</b> State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for poured in place concrete foundation walls in lieu of CMU, as indicated in the drawings and specifications.	_____
<b>3</b>	<b>Heavy Duty Fin Tube Covers ADD:</b> State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for heavy duty fin tube covers in lieu of standard covers, as indicated in the drawings and specifications.	_____
<b>4</b>	<b>Rubber Stair Treads and Risers ADD:</b> State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for rubber stair treads and risers from the garage to the first floor	_____

level including the entire first floor landing at exit stairs, as indicated in the drawings and specifications.

**5** \_\_\_\_\_ **Integrally Colored and Stamped Patio** **ADD:** \_\_\_\_\_ .

State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for integrally colored stamped concrete for the patio above the underground parking garage, as indicated in the drawings and specifications.

**6** \_\_\_\_\_ **Filter Fabric Under Asphalt Pavement** **ADD:** \_\_\_\_\_ .

State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for filter fabric under all asphalt pavement, as indicated in the drawings and specifications.

**7** \_\_\_\_\_ **Increase Garage Entry Lighting** **ADD:** \_\_\_\_\_ .

State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for increased garage entry lighting, as indicated in the drawings and specifications.

**8** \_\_\_\_\_ **Closed Cell Foam Insulation** **ADD:** \_\_\_\_\_ .

State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for 3-1/2" of closed cell foam insulation in lieu of batt insulation, as indicated in the drawings and specifications.

BIDDER has given the Architect and its consultants written notice of all conflicts, errors, or discrepancies that it has discovered in the Contract Documents and the written resolution by the Architect is acceptable to BIDDER.

The low bidder agrees to submit a list of sub-contractors (AIA G705) within 24 hours of the date of the bid.

In submitting this bid, the undersigned agree that this bid shall not be withdrawn for a period of fourteen days.

**Note: This Bid Form shall be submitted in DUPLICATE.**

**SIGNED:**

\_\_\_\_\_, a (Sole Proprietorship) (Partnership) (Corporation).

Firm Name \_\_\_\_\_ (strike through two)

\_\_\_\_\_  
Street Address

\_\_\_\_\_  
City, State ZIP code

Phone: \_\_\_\_\_ Fax: \_\_\_\_\_

\_\_\_\_\_, \_\_\_\_\_  
Signed By, Title

\_\_\_\_\_, \_\_\_\_\_  
Signed By, Title

\_\_\_\_\_, \_\_\_\_\_  
Signed By, Title

\_\_\_\_\_, \_\_\_\_\_  
Witnessed By, Title

- 1) Sole Proprietorship: Signature of Sole Proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature. Affix seal.
- 2) Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature. Affix seal to each signature.
- 3) Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and the secretary of the company, or the president/secretary/treasurer of the company, a copy of the by-law resolution of their board of director's authorizing them to do so, must be submitted with the Bid Form in the bid envelope.

**END OF SECTION**





## **SECTION 00 5000 - CONTRACTING FORMS AND SUPPLEMENTS**

### **PART 1 GENERAL**

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

### **1.02 AGREEMENT AND CONDITIONS OF THE CONTRACT**

- A. The Agreement form is AIA A101.
- B. The General Conditions are AIA A201.

### **1.03 FORMS**

- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the Contract Documents.
- B. Bond Forms:
  - 1. Performance and Payment Bond Form: AIA A312.
- C. Post-Award Certificates and Other Forms:
  - 1. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).
- D. Clarification and Modification Forms:
  - 1. Architect's Supplemental Instructions Form: AIA G710.
  - 2. Construction Change Directive Form: AIA G714.
  - 3. Change Order Form: AIA G701.
- E. Closeout Forms:
  - 1. Certificate of Substantial Completion Form: AIA G704.

### **1.04 REFERENCE STANDARDS**

- A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2007.
- B. AIA A201 - General Conditions of the Contract for Construction; 2007.
- C. AIA A312 - Performance Bond and Payment Bond; 2010.
- D. AIA G701 - Change Order; 2001.
- E. AIA G702 - Application and Certificate for Payment; 1992.
- F. AIA G703 - Continuation Sheet; 1992.
- G. AIA G704 - Certificate of Substantial Completion; 2000.
- H. AIA G710 - Architect's Supplemental Instructions; 1992.
- I. AIA G714 - Construction Change Directive; 2007.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## **SECTION 00 7300 - SUPPLEMENTARY CONDITIONS**

### **PART 1 - GENERAL**

The following supplements modify, change, delete from, or add to the General Conditions of the Contract for Construction, AIA Document A201, 2007. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

#### **ARTICLE 1 GENERAL PROVISIONS**

##### **1.1.3 THE WORK**

Add: 1.1.3.1 The term "provide" shall mean furnish and install in place.

1.1.5 After the paragraph, Add: The general character and scope of the Work is shown by the Drawings. Where a portion of the Work is fully drawn and the remainder is merely indicated, the portion fully drawn shall apply to all similar parts of the Work.

Add: 1.1.5.1 Figured dimensions on the Drawings shall be followed in preference to scaled measurements on the Drawings.

1.1.6 After the paragraph, Add: Where Specifications are abbreviated type, they indicate complete sentences in the same manner as when a note occurs in the Drawings. Omissions of words such as "the Contractor shall" and "as shown on the Drawings" is intentional. The words "shall" or "shall be" are to be supplied by inference.

Add: 1.1.6.1 Where a number is listed in the Specifications (as for gauges, weights, temperatures, amounts of time, etc.), the number shall be interpreted as that or better.

##### **1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS**

Add: 1.2.4 In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of Work shall be provided.

##### **1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE**

Add: 1.5.2.1 The Contractor(s) may retain one record set of Drawings and Project Manual(s).

#### **ARTICLE 2 OWNER**

##### **2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER**

2.2.5 Replace the text with: The Contractor(s) will be furnished as many sets of Drawings and Project Manuals as the Architect has available for distribution, but in no case less than one. If the Contractor(s) require additional sets, an electronic copy of the documents will be provided in Adobe PDF format with which the Contractor(s) may use to make additional copies at their expense.

## **ARTICLE 3 CONTRACTOR**

### **3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR**

3.2.1 At the end of the sentence add: "and geotechnical report, if any".

### **3.4 LABOR AND MATERIALS**

Add: 3.4.4 No trade shall commence Work until conditions are satisfactory for carrying out the Work properly, and surfaces to be covered are suitable.

Add: 3.4.5 Manufacturer's printed instructions covering details of installation shall be followed where not in conflict with these Specifications. If there is a conflict, notify the Architect and obtain Architect's approval before proceeding.

Add: 3.4.6 Completed Work shall be left plumb, level, true to line or plane, anchored securely in place, and free from damage.

Add: 3.4.7 Unless otherwise called for, all pieces of material shall be as large a stock size as is in conformity with standard good practice of the trade.

Add: 3.4.8 Except where in conflict with the Specifications, current manufacturer's printed instructions of herein specified proprietary products are made part of the Specifications.

### **3.5 WARRANTY**

Add: 3.5.1 The Contractor further warrants that all products, materials and equipment provided under the Contract are asbestos-free as defined under current EPA Guidelines, and that they do not contain any other materials currently known to be hazardous.

### **3.7 PERMITS, FEES AND NOTICES**

3.7.1 Change the word "...Contractor..." to read "...General Contractor..."

Add: 3.7.2.1 When the Contract Documents require Work better than that required by statute, the Contract Documents shall govern.

### **3.11 DOCUMENTS AND SAMPLES AT THE SITE**

3.11.1 Replace the text with: See Division 01, Section 01 3000 of the Project Manual.

## **ARTICLE 4 ARCHITECT**

### **4.1 GENERAL**

Add: 4.1.4: The Architect will not be responsible for the acts or omissions of the Owner.

### **4.2 ADMINISTRATION OF THE CONTRACT**

Add: 4.2.4.1 If there are any direct communications between the Owner and the Contractor(s) that affect the performance or Architect's administration of the Contract, a written summary of such communications shall be prepared by the Owner and a copy of said summary submitted to the Architect.

## **ARTICLE 5 SUBCONTRACTORS**

No supplement.

## **ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

No supplement.

## **ARTICLE 7 CHANGES IN THE WORK**

### **7.2 CHANGE ORDERS**

7.2.2 Neither the Owner nor the Architect are responsible to give Notice of Change Orders to the surety.

### **7.3 CONSTRUCTION CHANGE DIRECTIVES**

7.3.2 At the end of the sentence, Add: "or as deemed necessary by the Architect".

7.3.3.1 After "lump sum", Add: ", determined in accordance with the provisions of subparagraph 7.3.10,".

7.3.4 Add: "The costs for overhead, profit and commission shall be determined in accordance with the provisions of subparagraph 7.3.7.7."

7.3.7 At the end of the first sentence replace "a reasonable allowance for overhead and profit." with "allowances for overhead and profit as indicated in 7.3.7.7."

Add: 7.3.7.6 At a minimum the detailed breakdown shall include and indicate the terms enumerated below. Items (a) and (b) constitute the cost of labor, and items (a), (b), (c) and (d) constitute the basic costs referred to under this Article 7.

a. Labor costs, itemized by each trade involved, showing the hourly rates for each, and the hours required for the change. Labor rates shall be the same for extra and credit computations and shall be the actual rate paid the workmen in accordance with established labor management agreements.

b. Burden on labor, which shall be only the actual costs of mandatory fringe benefits required by established agreements, taxes on labor, worker's or workmen's compensation, insurance on labor as affected by payroll, unemployment taxes and insurance, including FICA and FUTA.

c. Quantities of materials, equipment and supplies, at their actual cost, with unit costs indicated, plus applicable sales tax.

The cost of subcontracted work, computed in the same way as provided for under this subparagraph.

d. Overhead, profit or commission added after the above computations are complete. Such overhead, profit or commission shall be computed in accordance with the provisions of subparagraph 7.3.7.7.

Add: 7.3.7.7 Maximum allowances for Subcontractor's/Contractor's overhead and profit shall be as follows, expressed as a percentage of the basic cost of the change:

For subcontractors: a.) 10% of the net cost of the additional Work.

For contractors: b.) 5% of the net cost of the additional Work performed by subcontractors.

c.) 10% of the net cost of the work performed by Contractor's own forces.

Overhead and profit shall include all bond premiums (if applicable), and will not be allowed on labor costs if overhead and profit is already included in hourly billing rate.

Add: 7.3.7.8 For proposed changes in the Work on the lump sum or time and material methods, the costs shall be determined as provided in this subparagraph. The Contractor shall submit an itemized list of quantities with the applicable unit costs and extended price for each, in such form and detail as required by the Architect.

## **ARTICLE 8 TIME**

### **8.1 DEFINITIONS**

8.1.3 At the end of the paragraph, Add: "Minor corrective Work and the replacement of defective Work or materials, and the adjustment of control apparatus, will not delay the determination that the Contract is Substantially Complete. See Paragraph 12.2.2."

Add: 8.1.3.1 The date of Final Completion is the date certified by the Architect in accordance with Paragraph 9.10.2.

### **8.2 PROGRESS AND COMPLETION**

Add: 8.2.1.1 The Date of Substantial Completion and the Date of Final Completion are as specified in Section 00 2113 - Instructions to Bidders. If the Work is not Substantially Complete on or before the date specified or other date as granted by Change Order, the Contractor shall pay to the Owner as liquidated damages the sum of \$30,000 the first day and \$500 for each additional calendar day of delay. Any monies due to the Owner as liquidated damages will be deducted from any monies due or to become due to the Contractor under the Contract, or will be collected from the Contractor's surety.

### **8.3 DELAYS AND EXTENSIONS OF TIME**

Add: 8.3.1.1 The following will not be considered justifications for extension of time unless due to one of the causes stated within Section 8.3.1.2:

- a) Delay caused by Subcontractors or Supplier except if the Supplier goes out of business and another Supplier cannot be found in time to meet the schedule.
- b) Shortage of workmen.

Add: 8.3.1.2 Change Orders for extension of Contract Time shall be considered only under the following conditions or circumstances:

.1 As indicated in Paragraph 8.3.1. The burden of proof to substantiate the extension of time shall rest with the Contractor, including evidence that the cause was beyond his control. The Contractor shall be deemed to have had control of the supply of labor except in the case of organized labor disputes, materials, equipment, methods, and techniques, and of the Subcontractors.

.2 A delay in the progress of the Work actually occurred as a result of one of the valid causes for time extension.

.3 Unusual delay in delivery solely due to a delay in transportation. An extension of time shall not be considered when delay in delivery is due to improperly scheduled delivery, or when an order has not been promptly and properly placed.

.4 Abnormal weather conditions. The Contractor shall consider the location of the Project, and shall recognize the existence of variations from severe deviations from average climatic conditions. Foul weather in and of itself shall not be a valid cause for a time extension. Time extensions resulting from abnormal weather shall not be considered unless a significant deviation from average seasonal climatic conditions occurred for an extended period of time, and the progress of the Work was delayed to a significant extent. The climatic conditions before and after the period for which the delay is sought shall be evaluated.

.5 Changes in the Work which significantly affect the progress of the Work. When the anticipated delay can be determined the extension will be made when the Change in Work is authorized by the Owner. When the anticipated delay cannot be determined, the Contractor shall estimate the additional time required, and a mechanism for all parties to determine the allowable delay. In such a case, the Architect will determine the time extension and the Contract Time adjusted accordingly by Change Order. For changes in the Work which affect only a portion or Phase of the entire project, the Owner reserves the right to grant a time extension only for that portion or Phase affected by the Change.

.6 Labor disputes except for lockouts over which the Contractor has control. The amount of time extension shall not be longer than the actual dispute period plus a reasonable time for mobilization, and such extension may be less than the actual dispute period depending on the effect the dispute had upon the progress of the Work.

.7 Unavoidable delays such as damage caused by severe weather, fire or other casualty to the Work; remediation of contaminants, pollutants, or hazardous materials or substances discovered after award of the Contract; litigation including without limitation bankruptcy proceedings; the acts of any federal, state or local government unit that directly result in delays; and other delays outside the control of the Party claiming the delay.

.8 Delays caused by Subcontractors shall be considered only under the conditions noted above.

.9 Time extensions may be granted through a change order for substantiated abnormal weather conditions, however, no change to the contract price will be granted.

Add: 8.3.1.3 Time extensions shall not be granted as a result of delays caused by improper scheduling, or by failure of the Contractor to have Shop Drawings or other required submittals submitted in sufficient time for review.

## **ARTICLE 9 PAYMENTS AND COMPLETION**

### **9.3 APPLICATIONS FOR PAYMENT**

9.3.1 In the first sentence replace: "At least ten days before the date established for each progress payment," with: "Not more than once a month,".

Add 9.3.4 Progress payments shall be made monthly upon application, in the amount of 90% of the Work completed. For a Contract of over \$100 thousand, the Architect will authorize the payment of 100% of the amount completed after a total of 5% of the Contract amount has been retained, providing progress on the Work is in accordance with or ahead of the Contractor's construction schedule and is satisfactory to the Architect and if the Contractor has filed a Consent of Surety with the Architect.

## **9.8 SUBSTANTIAL COMPLETION**

9.8.1 At the end of the paragraph Add: In all cases, the date of the Substantial Completion may not be earlier than the Certificate of Occupancy issued by the authority having jurisdiction. Minor corrective Work, the replacement of defective Work or materials, and the adjustment of control apparatus will not delay the determination of Substantial Completion. See paragraph 12.2.2.

9.8.2 At the end of the paragraph Add: Minor punch list items that do not interfere with using the Work as intended may be corrected between Substantial Completion and Final Completion.

## **9.10 FINAL COMPLETION AND FINAL PAYMENT**

9.10.2 After "consent of surety, if any, to final payment" DELETE "and (5)" and REPLACE WITH ",(5) written certification from Contractor in accordance with Final Inspection requirements of Section 01 7800, (6) all Contract Closeout submittals required by Section 01 7800, each submittal having been approved by the Architect, and (7)".

## **ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY**

### **10.3 HAZARDOUS MATERIALS**

10.3.1 In the first sentence after: "asbestos", Add: ", lead-containing materials,"

## **ARTICLE 11 INSURANCE**

### **11.1 CONTRACTOR'S LIABILITY INSURANCE**

11.1.4 Replace the paragraph with the following: "To the fullest extent permitted by law, the Contractor shall cause the commercial liability coverage required by the Contract Documents 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 during the Contractor's completed operations. Additional-insured coverage shall be primary and non-contributory and shall be equal to or greater than that provided by Forms CG 20 10 04 13 and CG 20 37 04 13 as published by the Insurance Services Office (ISO). The applicable additional-insured endorsements shall be attached to the certificates of insurance provided pursuant to Paragraph 11.1.3."

11.1.1.9 Liability Insurance shall be provided by each Prime Contractor and shall include the following:

Commercial General Liability on an Occurrence Basis, including Premises/Operations, Products/Completed Operations and Personal Injury. (There shall be no endorsements deleting XCU coverages where they are applicable.)

Automobile Liability: Written on a Business Auto Policy with liability covered auto symbols (1) or (2, 8 and 9). If the carrier does not use the Business Auto Policy, an equivalent form providing liability coverage on a comprehensive basis including all owned, non-owned and hired autos shall be used.

Umbrella Liability or Excess Liability with minimum limits of \$5,000,000 per occurrence and \$5,000,000 yearly aggregate amount. The self-insured retention shall not exceed \$500,000. The policy shall provide a minimum of following form liability over the previous specified general liability and automobile liability.



The Architect and Owner assume no responsibility in the event that the limits set above are not adequate.

The Owner and Architect shall be listed as additional insured on each Contractor's General Liability and Automobile Liability policies.

11.1.2 Replace the first sentence with: The insurance required by Section 11.1.1 shall be written for not less than the limits of liability specified in Section 11.1.2.1 or required by law, whichever coverage is greater.

Add: 11.1.2.1 Limits of liability shall be as follows:

Comprehensive General Liability:

Bodily Injury:

Each Occurrence: \$1,000,000

Annual Aggregate: \$2,000,000

Property Damage:

Each Occurrence: \$1,000,000

Annual Aggregate: \$2,000,000

Products and Completed Operations to be maintained for one year after final payment.

Property Damage Liability Insurance will provide X (explosion), C (collapse), or U (underground) coverage as applicable.

Contractual Liability - Bodily Injury and Property Damage Combined Single Limit:

Bodily Injury:

Each Occurrence: \$1,000,000

Annual Aggregate: \$2,000,000

Property Damage:

Each Occurrence: \$1,000,000

Annual Aggregate: \$2,000,000

Personal Injury: Annual Aggregate: \$1,000,000.

Comprehensive Automobile Liability:

Bodily Injury:

Each Occurrence: \$500,000

Annual Aggregate: \$1,000,000

Property Damage:

Each Occurrence: \$200,000

Umbrella:

Umbrella Liability or Excess Liability with minimum limits of \$5,000,000 per occurrence and \$5,000,000 aggregate. The self-insured retention, if written on an umbrella liability form, shall not exceed \$10,000. The policy shall provide a minimum of following form liability over the previous specified general liability and automobile liability. The amounts listed for Umbrella coverage include the total of the amount of the basic coverage plus Umbrella coverage.

Worker's Compensation

Applicable State: Statutory

Applicable Federal: Statutory

Employer's Liability: \$500,000

Contractor's Property Damage Insurance specified shall cover property that the Contractor did not provide and that is damaged by the Contractor while he is working on other items in the vicinity.

Other insurance deemed necessary by the Contractor, including, but not limited to, coverage on contractor's or subcontractor's equipment.

11.1.3 Replace the first sentence with: "Proof of workmen's compensation insurance coverage shall be a copy of Certificate of Premium Payment and proof of other insurance coverage shall be a fully descriptive standard AIA or ACCORD Certificate of Insurance. The Certificate of Insurance portrays the Insurance Agent's description of coverages provided the Contractor. Such certificates shall be filed with the Owner prior to commencement of the Work."

### **11.3 PROPERTY INSURANCE**

11.3.1 Modify the last sentence by adding "the Architect and Engineers," after "the Owner,".

11.3.1.1 Add: The form of the policy for this coverage shall be completed value. The Owner shall furnish evidence of coverage to the Architect and the Contractor.

11.3.1.6 The insurance required by Paragraph 11.3 is not intended to cover machinery, tools or equipment owned or rented by the Contractor that are utilized in the performance of the Work but not incorporated into the permanent improvements. The Contractor shall, at the Contractor's own expense, provide insurance coverage for owned or rented machinery, tools or equipment which shall be subject to the provisions of Subparagraph 11.3.7.

11.3.1.3 Replace the text with: If the Builder's Risk Insurance is written with a stipulated amount deductible under the terms of the policy, the cost of such deductible amount required on claims paid by the insurance shall be paid as follows: 1.) For claims made by Mechanical or Electrical Sub-contractors, the Sub-contractor making the claim shall pay the deductible amount up to \$1,000 for each claim. If the deductible amount is larger, the General Contractor shall pay the difference between \$1,000 and the actual deductible amount; 2.) For claims made by the General Contractor, the General Contractor shall pay the total deductible amount; 3.) For claims involving more than one Prime Contractor's work the deductible amount will be assessed to each Prime Contractor on the basis of percent of involvement in claim by each. The General Contractor is encouraged to maintain adequate security and take other precautionary steps as required to minimize the risks covered by this insurance.

11.3.8 At the end of the first sentence add: "except when the fiduciary consents to allow a party with a claim to settle directly with the insurer."

### **11.4 PERFORMANCE BOND AND PAYMENT BOND**

11.4.1 Replace the text in its entirety with: The Contractor shall furnish bond or bonds as described below, covering the faithful performance of the Contract and the payments of all obligations arising thereunder. The Contract will not be executed by the Owner until the Owner has received the properly executed bond or bonds specified under this Article, issued by a bonding company and licensed to do business in the jurisdictional where the Project is located.

11.4.2 Replace the text in its entirety with: Where there are State, Federal or other jurisdictional bond forms required by statute or regulation, the bond or bonds shall be on those forms, in the amount of 100% of the Contract amount. Where no such requirements exist, the Contractor shall furnish both AIA A312 Performance and AIA A312 Labor and Material Payment Bond. Each bond, Performance and Payment, shall be in the amount of 100% of the Contract amount.

Add: 11.4.3 The Contractor shall require the attorney-in-fact who executes the required bond or bonds on behalf of the surety to affix thereto a certified and correct copy of the power of attorney.

Add 11.4.4 Bond amounts shall not exceed the single bond limit for the Contractor's bonding company as set forth in the Federal Register current as of the bid date.

## **ARTICLE 12 UNCOVERING AND CORRECTION OF WORK**

**No supplement.**

## **ARTICLE 13 MISCELLANEOUS PROVISIONS**

**No supplement.**

## **ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT**

### **14.2 TERMINATION BY THE OWNER FOR CAUSE**

14.2.1.2 At the end of the Subparagraph Add "or in accordance with the Contract Documents".

Add: 14.2.1.5 files a bankruptcy petition or has a bankruptcy action commenced against it that is not discharged within 30 days of commencement of same, makes an assignment for the benefit of its creditors, has a receiver appointed to manage the Contractor's assets or otherwise becomes insolvent;

Add: 14.2.1.6 fails to maintain schedules as required by the Contract Documents, or fails to comply in a material way with design requirements of the Contract Documents, or persistently fails to perform the Work in accordance with the Contract Documents.

14.2.4 Replace the text with: If the unpaid balance of the Contract Sum exceeds the direct and indirect consequential costs of completing the Work (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and court and arbitration costs), and other damages incurred by the Owner, such excess will be paid to the Contractor. If such costs and damages exceed such unpaid balance, the Contractor shall pay the difference to the Owner. Such costs incurred by the Owner will be approved as to reasonableness by the Architect, but when exercising any rights or remedies under this paragraph, the Owner shall not be required to obtain the lowest price for the Work performed. This obligation to payment shall survive termination of the Contract.

**END OF SECTION**

### **SECTION 3 CONTRACTING CLAUSE**

- A. The work to be performed under this contract is subject to the requirements of section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing.
- B. The parties to this contract agree to comply with HUD's regulations in 24 CFR part 135, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 135 regulations.
- C. The contractor agrees to send to each labor organization or representative of workers with which the contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the contractor's commitments under this section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin.
- D. The contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR part 135, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR part 135. The contractor will not subcontract with any subcontractor where the contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR part 135.
- E. The contractor will certify that any vacant employment positions, including training positions, that are filled (1) after the contractor is selected but before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 135 require employment opportunities to be directed, were not filled to circumvent the contractor's obligations under 24 CFR part 135.
- F. Noncompliance with HUD's regulations in 24 CFR part 135 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.
- G. With respect to work performed in connection with section 3 covered Indian housing assistance, section 7(b) of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450e) also applies to the work to be performed under this contract. Section 7(b) requires that to the greatest extent feasible (i) preference and opportunities for training and employment shall be given to Indians, and (ii) preference in the award of contracts and subcontracts shall be given to Indian organizations and Indian-owned Economic Enterprises. Parties to this contract that are subject to the provisions of section 3 and section 7(b) agree to comply with section 3 to the maximum extent feasible, but not in derogation of compliance with section 7(b).

# **SECTION 01 2000 - 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. Procedures for preparation and submittal of application for final payment.

### **1.02 RELATED REQUIREMENTS**

- A. Section 00 5000 - Contracting Forms and Supplements: Forms to be used.
- B. Document 00 7200 - General Conditions and Document 00 7300 - Supplementary Conditions: Additional requirements for progress payments, final payment, changes in the Work.

### **1.03 SCHEDULE OF VALUES**

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values to the Architect at the earliest feasible date, but in no case later than seven days before the date scheduled for submittal of the initial application for payment.
- D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section.
  - 1. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports.
  - 2. Break principle subcontract amounts down into several line items.
  - 3. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.
  - 4. For each part of the Work where an Application for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
  - 5. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Application for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.
  - 6. At the Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.
- E. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
  - 1. Contractor's construction schedule.
  - 2. Application for Payment form.

3. List of subcontractors.
  4. List of principal suppliers and fabricators.
- F. 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. Form to be used: AIA G702 and G703.
- C. Forms filled out by hand will not be accepted.
- D. Execute certification by signature of authorized officer.
- E. 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.
- F. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
- G. Submit three copies of each Application for Payment to the Architect by means ensuring receipt within 24 hours; one copy shall be complete, including waivers of lien, payroll reports, and/or similar attachments, when required.
1. One approved copy will be retained by the Architect, one will be returned to the Contractor, and one forwarded to the Owner for their use in issuing payment.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:
1. List of subcontractors: AIA G705.
  2. List of principle suppliers and fabricators.
  3. Schedule of Values: AIA G703.
  4. Contractor's Construction Schedule (preliminary if not final).
  5. Schedule of principal products.
  6. List of Contractor's staff assignments.
  7. Certificates of insurance and insurance policies.
  8. Performance and payment bonds: AIA A312.
- I. Include the following with each application:
1. Waivers of Mechanics Lien: Submit waivers of mechanics lien from every entity who may lawfully be entitled to file a mechanics lien arising out of the Contract, and related to the Work covered by the payment.
  2. Construction progress schedule, revised and current as specified in Section 01 3216.
  3. Affidavits attesting to off-site stored products.
- J. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
1. Administrative actions and submittals that shall precede or coincide with this application include:
    - a. Occupancy permits and similar approvals.
    - b. Warranties (guarantees) and maintenance agreements.
    - c. Testing, adjusting, and balancing reports.
    - d. Maintenance instructions.

- e. Start-up performance reports.
- f. Change-over information related to Owner's occupancy, use, operation, and maintenance.
- g. Final cleaning.
- h. Application for reduction of retainage, and consent of surety.
- i. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

## 1.05 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue Supplemental Instructions on AIA form G710 directly to Contractor.
- B. Change Orders: 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 and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.
  - 1. Owner-Initiated Proposal Requests: Proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time will be issued by the Architect, with a detailed description of the proposed change and supplemental or revised Drawings and Specifications, if necessary.
    - a. Proposal requests issued by the Architect are for information only. Do not consider Proposal Requests as an instruction either to stop work in progress, or to execute the proposed change.
    - b. Unless otherwise indicated in the proposal request, within 5 days of receipt of the proposal request, submit to the Architect for the Owner's review an estimate of cost necessary to execute the proposed change.
    - c. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
    - d. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - e. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.
  - 2. Contractor-Initiated Change Order Proposal Requests: When latent or other unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the Architect.
    - a. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
    - b. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
    - c. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - d. Comply with requirements in Section "Product Substitutions" if the proposed change in the Work requires the substitution of a product or system for a product or system specified.
  - 3. Proposal Request Form: Use AIA Document G709 for Change Order Proposal Requests.
- C. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
  - 1. Maximum allowances for Subcontractor's/Contractor's overhead and profit as expressed as a percentage of the basic cost of the change:
    - a. Subcontractors: 10% of the net cost of the additional Work.

- b. Contractors: 5% of the net cost of the additional Work performed by subcontractors.
  - c. Contractors: 10% of the net cost of work performed by the contractor's own forces.
  - d. Overhead and profit shall include all bond premiums (if applicable), and will not be allowed on labor costs if overhead and profit is already included in hourly billing rate.
- D. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- E. 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.
- F. 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.
- G. 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 7000.
  2. Completion of items specified for completion after Substantial Completion (punchlists).
  3. Assurance that unsettled claims will be settled.
  4. Assurance that Work not complete and accepted will be completed without undue delay..
  5. Transmittal of required construction records to Owner.
  6. Release of mechanics lien waivers.
  7. Proof taxes, fees, and similar obligations have been paid.
  8. Removal of temporary facilities and services.
  9. Removal of surplus materials, rubbish, and similar elements.

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

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

#### **END OF SECTION**



## **SECTION 01 2100 - ALLOWANCES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Cash and material allowances.
- B. Payment and modification procedures relating to allowances.

#### **1.02 RELATED REQUIREMENTS**

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

#### **1.03 CASH AND MATERIAL ALLOWANCES**

- A. Costs Included in Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts.
- B. Architect Responsibilities:
  - 1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
  - 2. Select products in consultation with Owner and transmit decision to Contractor.
  - 3. Prepare Change Order.
- C. Contractor Responsibilities:
  - 1. Assist Architect in selection of products, suppliers, and installers.
  - 2. Obtain proposals from suppliers and installers and offer recommendations.
  - 3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
  - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
  - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- D. Differences in costs will be adjusted by Change Order.

#### **1.04 ALLOWANCES SCHEDULE**

- A. Playground Equipment: Provide a \$25,000.00 allowance for furnishing and installation of playground equipment.
- B. Playground Surfacing: Provide a \$25,000.00 allowance for furnishing and installation of playground surfacing.

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

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

### **END OF SECTION**



## **SECTION 01 2300 - ALTERNATES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

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

#### **1.02 DEFINITIONS**

- A. Alternate: An alternate is an amount proposed by Bidders and stated on the Bid Form for certain construction activities defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

#### **1.03 ACCEPTANCE OF Alternates**

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.
- C. Work Included Under Each Alternate: Make modifications to work required by each alternate selected at no additional cost to the Owner other than as proposed on the Bid Form. Bidders shall be responsible for alternates and shall see that all changes are covered under their related sections, whether specifically called out or not. Extra costs incurred due to modifications to or deviations from the Drawings or Specifications caused directly or indirectly by each alternate shall be included in each alternate bid.

#### **1.04 SCHEDULE OF Alternates**

- A. Alternate No. 1: Condo Pack Heating and Cooling Units.
  - 1. State the amount to be DEDUCTED from the Base Bid to provide all materials, labor & equipment required for Condo Pack heating and cooling units in lieu of ventilation, AC units and hot water heat systems, as indicated in the drawings and specifications.
  - 2. See Design Narrative following this Section.
- B. Alternate No. 2: Poured in Place Concrete Foundation.
  - 1. State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for poured in place concrete foundation walls in lieu of CMU, as indicated in the drawings and specifications.
- C. Alternate No. 3: Heavy Duty Fin Tube Covers.
  - 1. State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for heavy duty fin tube covers in lieu of standard covers, as indicated in the drawings and specifications.
- D. Alternate No. 4: Rubber Stair Treads and Risers.

1. State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for rubber stair treads and risers from the garage to the first floor level including the entire first floor landing at exit stairs, as indicated in the drawings and specifications.
- E. Alternate No. 5: Integrally Colored and Stamped Patio.
1. State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for integrally colored stamped concrete for the patio above the underground parking garage, as indicated in the drawings and specifications.
- F. Alternate No. 6: Filter Fabric Under Asphalt Pavement.
1. State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for filter fabric under all asphalt pavement, as indicated in the drawings and specifications.
- G. Alternate No. 7: Increase Garage Entry Lighting.
1. State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for increased garage entry lighting, as indicated in the drawings and specifications.
- H. Alternate No. 8: Closed Cell Foam Insulation.
1. State the amount to be ADDED to the Base Bid to provide all materials, labor & equipment required for 3-1/2" of closed cell foam insulation in lieu of batt insulation in exterior walls, as indicated in the drawings and specifications. Omit <VPR RET-1> on interior face of exterior stud walls. Replace <AIR BAR-1> with <VPR RET-10> on exterior face of sheathing.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



## DESIGN NARRATIVE – M1

Date	November 29, 2017
Project #	2016446
Project Name	Bottineau Ridge II Apartment Building
Project Location	Maple Grove, MN
Description	Alternate 1 mechanical scope

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### PART 1. ALTERNATE 1 MECHANICAL GENERAL INFORMATION

#### 1.1 OVERVIEW

- A. This narrative delineates the scope for Alternate 1 for the Bottineau Ridge II Apartment Building located in Maple Grove, MN. The scope includes changing the mechanical, heating and cooling systems for the facility as well as the domestic hot water plant.

#### 1.2 SCOPE

- A. This narrative document summarizes changes in the mechanical systems for Alternate 1 including the design concepts for the major mechanical systems including Plumbing (Division 22), HVAC and Temperature Controls. (Division 23)
- B. Plumbing systems (Division 22) included in this document:
1. Plumbing Piping
  2. Domestic Water Heater
- C. HVAC (Division 23) included in this document:
1. Heating water piping
  2. Perimeter Supplemental Heating Equipment
  3. Boiler Plant
  4. HVAC Equipment
  5. Ductwork & Distribution
  6. Testing and Balancing.
  7. Temperature Control Systems

#### 1.3 TECHNICAL CRITERIA

- A. Codes: The following is a partial list of applicable codes governing the systems described herein:
1. Minnesota Mechanical and Fuel Gas Code
  2. Minnesota Fire Code
  3. Minnesota Energy Conservation Code
  4. Minnesota Plumbing Code
  5. NFPA 101 Life Safety Code.
  6. NFPA 13 Installation of Fire Protection Systems.
  7. MHFA Guidelines.

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#### BUILDING SYSTEMS CONSULTANTS

8. Americans with Disabilities Act (ADA).
9. ASHRAE 90.1

## **PART 2. PLUMBING SYSTEMS (DIVISION 22)**

### **2.1 PLUMBING PIPING**

- A. Add vented stand pipes and drain piping for each stacked self-contained AC unit (SCU) closet. Provide drain at lowest level to connect to the sanitary system.
- B. Add tenant gas meter array and individual runouts to each SCU closet.
- C. Extend gas piping to new water heaters and gas fired unit heaters for the garage.

### **2.2 DOMESTIC WATER HEATER**

- A. Remove Boilers. Add two gas fired condensing water heater sized adequately for the facility. PVI Conquest or equal.

## **PART 3. HVAC (DIVISION 23)**

### **3.1 HEATING WATER PIPING**

- A. Remove all hydronic hot water piping.

### **3.2 PERIMETER AND SUPPLEMENTAL HEATING EQUIPMENT**

- A. Remove all finned tube radiation in the facility.
- B. Remove all hot water unit heaters in the garage.
- C. Remove all hot water cabinet unit heaters in the vestibules.

### **3.3 BOILER PLANT**

- A. Remove hydronic hot water heating plant in its entirety including:
  1. Boilers
  2. Air Separator
  3. Expansion tank
  4. Pumps
  5. Hydronic hot water piping
  6. Gas piping to boilers
  7. Domestic hot water heat exchanger

### **3.4 FAN COIL UNITS**

- A. FCU-1: Remove fan coil unit system in its entirety. Remove all ductwork for this system. Remove condensing unit and refrigerant piping.

- B. FCU-2: Remove system in its entirety and replace with gas fired furnace and DX coil with matching condensing unit. Furnace shall be sealed combustion and 95% efficient or better. Provide gas connection off house meter. Provide combustion air and vent connections with concentric vent kit to the exterior. New equipment shall be sized the same as equipment removed. Equipment shall be manufactured by Trane, Carrier, Bryant or equal.
- C. FCU-3: Remove system in its entirety and replace with gas fired furnace and DX coil with matching condensing unit. Furnace shall be sealed combustion and 95% efficient or better. Provide gas connection off house meter. Provide combustion air and vent connections with concentric vent kit to the exterior. New equipment shall be sized the same as equipment removed. Equipment shall be manufactured by Trane, Carrier, Bryant or equal.
- D. FCU-4: Remove system in its entirety and replace with gas fired furnace and DX coil with matching condensing unit. Furnace shall be sealed combustion and 95% efficient or better. Provide gas connection off house meter. Provide combustion air and vent connections with concentric vent kit to the exterior. New equipment shall be sized the same as equipment removed. Equipment shall be manufactured by Trane, Carrier, Bryant or equal.

### **3.5 SELF CONTAINED HEATING AND AC UNITS (SCU)**

- A. Provide self contained heating and AC unit for each apartment. Provide complete supply, return and ventilation air ductwork including all envelope penetrations. Insulate ductwork as required by the energy code.

### **3.6 GARAGE HEATING**

- A. Add gas fired unit heaters, Reznor or equal, sized for an equal heating output as the hot water unit heaters that were removed. Provide gas connection off house meter.

### **3.7 DUCTWORK & DISTRIBUTION**

- A. Remove distribution ductwork for FCU-1.
- B. Add supply, return and ventilation ductwork for each SCU.

### **3.8 TESTING AND BALANCING**

- A. All water and air systems will be tested by a 3rd part Testing And Balancing (TAB) agency. The TAB contractor will be either NEBB or AABC certified for balancing commercial HVAC and Plumbing systems.

### **3.9 AUTOMATIC TEMPERATURE CONTROLS**

- A. Provide heat/cool programmable 5/2 thermostat for each self contained unit.
- B. Provide individual thermostats for each gas fired unit heater.





## **SECTION 01 2500 - SUBSTITUTION PROCEDURES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 00 2600 - Procurement Substitution Procedures: Required form for substitutions requests made before the end of bidding (during procurement).
- B. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- C. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

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

### **PART 3 EXECUTION**

#### **3.01 GENERAL REQUIREMENTS**

- A. 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.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  - 1. Forms included in the Project Manual are adequate for this purpose, and must be used.
- D. Limit each request to a single proposed substitution item.
  - 1. Submit an electronic document, combining the request form with supporting data into single document.

#### **3.02 SUBSTITUTION PROCEDURES DURING BIDDING PHASE**

- A. Section 00 2600 - Procurement Substitution Procedures specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.

### **3.03 SUBSTITUTION PROCEDURES AFTER BIDDING PHASE**

- A. Submittal Form (after contract award):
  - 1. Submit substitution requests by completing the form in Section 00 2113; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Architect will consider requests for substitutions only within 30 days after date of Agreement. Requests for substitutions after the bids have been received are done so at the risk of the Contractor. Substitutions may not be granted.
- C. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- D. Substitutions will not be considered under one or more of the following circumstances:
  - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
  - 2. Without a separate written request.
  - 3. When acceptance will require revisions to the Contract Documents.

### **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.

## **END OF SECTION**

# **SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Preconstruction meeting.
- B. Progress meetings.
- C. Submittals for review, information, and project closeout.
- D. Requests for Information (RFI) procedures.
- E. Submittal procedures.

### **1.02 RELATED REQUIREMENTS**

- A. Section 01 3216 - Construction Progress Schedule: Form, content, and administration of schedules.
- B. Section 01 3329 - Green Building Requirements: Reporting related to sustainability certification project procedures.
- C. Section 01 6000 - Product Requirements: General product requirements.

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

## **PART 3 EXECUTION**

### **3.01 PRECONSTRUCTION MEETING**

- A. Schedule meeting after Notice of Award.
- B. Attendance Required:
  - 1. Owner.
  - 2. Architect.
  - 3. Contractor.
  - 4. Major subcontractors.
- 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.
    - a. Contractor's schedule.
    - b. Start of on-site work.
    - c. Completion date.
    - d. Coordination with on-site Owner's representatives.
    - e. Sequence of work.

- f. Full or partial Owner occupancy as applicable.
- 8. Shop drawings and sample distribution.
- 9. Mockups.
- 10. Critical products for the project timeline.
- 11. Material deliveries.
- 12. Procedures to be followed when working on site.
- 13. Address items prior to on-site work.
  - a. Parking.
  - b. Security.
  - c. Temporary Facilities including heat, electricity and water.
  - d. Noise and general safety.
  - e. Site fencing.
  - f. Use of the site.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.02 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. Review of off-site fabrication and delivery schedules.
  - 7. Maintenance of progress schedule.
  - 8. Corrective measures to regain projected schedules.
  - 9. Planned progress during succeeding work period.
  - 10. Coordination of projected progress.
  - 11. Maintenance of quality and work standards.
  - 12. Effect of proposed changes on progress schedule and coordination.
  - 13. Other business relating to work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.03 CONSTRUCTION PROGRESS SCHEDULE - See Section 01 3216**

### **3.04 REQUESTS FOR INFORMATION (RFI)**

- A. Definition: A request seeking one of the following:

1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
  2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of the Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
    - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    - b. Do not forward requests which solely require internal coordination between subcontractors.
  2. Prepare in a format and with content acceptable to Owner.
  3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from the Contract Documents information requiring interpretation.
  2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
    - a. Approval of submittals (use procedures specified elsewhere in this section).
    - b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
    - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
    - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
  3. Improper RFIs: Requests not prepared in conformance to requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
  4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
    - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
  2. Owner's, Architect's, and Contractor's names.
  3. Discrete and consecutive RFI number, and descriptive subject/title.
  4. Issue date, and requested reply date.
  5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
  6. Annotations: Field dimensions and/or description of conditions which have engendered the request.

7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
  - G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
    1. Indicate current status of every RFI. Update log promptly and on a regular basis.
    2. Note dates of when each request is made, and when a response is received.
    3. Highlight items requiring priority or expedited response.
    4. Highlight items for which a timely response has not been received to date.
    5. Identify and include improper or frivolous RFIs.
  - H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
    1. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
    2. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.

### **3.05 SUBMITTAL SCHEDULE**

- A. Submit to Architect for review a schedule for submittals in tabular format.
  1. Coordinate with Contractor's construction schedule and schedule of values.
  2. Format schedule to allow tracking of status of submittals throughout duration of construction.
  3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
  4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
    - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

### **3.06 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  1. Product data.
  2. Shop drawings.
  3. Samples for selection.
  4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed 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 7800 - Closeout Submittals.

### **3.07 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.

### **3.08 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 conformance to requirements of Section 01 7800 - 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.

### **3.09 SUBMITTAL PROCEDURES**

- A. General Requirements:
  - 1. Use a separate transmittal for each item.
  - 2. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
  - 3. 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.
    - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
  - 4. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
  - 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.
    - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
    - c. Color selections will not be reviewed or approved until all related products are submitted to ensure a cohesive palette.
    - d. Products that make up a system, assembly, or that are directly related to each other often must be reviewed together. Review will not begin until all components are submitted.

- e. Coordinate with Architect and/or Construction Manager, as applicable, where schedule dictates an expedited review of products.
  - 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. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
- B. Product Data Procedures:
- 1. Submit only information required by individual specification sections.
  - 2. Collect required information into a single submittal.
  - 3. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
- 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related work.
  - 2. Do not reproduce the Contract Documents to create shop drawings.
  - 3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
- 1. Transmit related items together as single package.
  - 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
- E. Do not use shop drawings without an appropriate final stamp indicating action taken in connection with construction.

### **3.10 SUBMITTAL REVIEW**

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
- D. Architect's and his consultants' actions on items submitted for review:
- 1. Authorizing purchasing, fabrication, delivery, and installation:
    - a. "Approved", or language with same legal meaning.
    - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
      - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
    - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
      - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
  - 2. Not Authorizing fabrication, delivery, and installation:
    - a. "Revise and Resubmit".



- 1) Resubmit revised item, with review notations acknowledged and incorporated.
  - b. "Rejected".
    - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and his consultants' actions on items submitted for information:
  1. Items for which no action was taken:
    - a. "Received" - to notify the Contractor that the submittal has been received for record only.
  2. Items for which action was taken:
    - a. "Reviewed" - no further action is required from Contractor.

**END OF SECTION**



# **SECTION 01 3216 - CONSTRUCTION PROGRESS SCHEDULE**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

### **1.02 SUBMITTALS**

- A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. Submit updated schedule with each Application for Payment.

### **1.03 SCHEDULE FORMAT**

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- B. Diagram Sheet Size: Maximum 22 x 17 inches (560 x 432 mm) or width required.

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

## **PART 3 EXECUTION**

### **3.01 PRELIMINARY SCHEDULE**

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

### **3.02 CONTENT**

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and other logically grouped activities.
- D. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- E. Provide legend for symbols and abbreviations used.

### **3.03 BAR CHARTS**

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

### **3.04 REVIEW AND EVALUATION OF SCHEDULE**

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

### **3.05 UPDATING SCHEDULE**

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

### **3.06 DISTRIBUTION OF SCHEDULE**

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

## **END OF SECTION**

# **SECTION 01 3329 - GREEN BUILDING REQUIREMENTS**

## **PART 1 GENERAL**

### **1.01 PROJECT GOALS**

- A. This project has been designed as a green building. The full cooperation of contractor and subcontractors is essential to the success of the Project.
- B. Contractor shall familiarize himself with the relevant requirements and provide the necessary information and instruction to all subcontractors and installers.
- C. Since Contractor and subcontractors may not be familiar with sustainable design requirements, this section includes a summary of the products and procedures intended to achieve sustainable design credits.
  - 1. Some credits are dependent on proper performance by Contractor and subcontractors.
  - 2. Other credits involve quantifying percentages by weight or volume and cost; these require careful recordkeeping and reporting by the Contractor.
  - 3. See [www.usgbc.org](http://www.usgbc.org) for more information.

### **1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Additional submittal requirements.
- B. Section 01 4000 - Quality Requirements.
- C. Section 01 5721 - Indoor Air Quality Controls.
- D. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- E. Section 01 7419 – Construction Waste Management and Disposal.

### **1.03 REFERENCE STANDARDS**

- A. ASHRAE: American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc.
- B. BAAQMD: Bay Area Air Quality Management District; [www.baaqmd.gov](http://www.baaqmd.gov).
- C. CRS: Center for Resource Solutions; [www.green-e.org](http://www.green-e.org).
- D. Green Seal; [www.greenseal.org](http://www.greenseal.org).
- E. SCAQMD: South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).
- F. Minnesota Green Communities Guidelines; [www.greencommunitiesonline.org/minnesota](http://www.greencommunitiesonline.org/minnesota).

### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for additional submittal procedures.
- B. Sustainable Design Documentation: The scope of required documentation is specified in some individual specification sections; other scope is specified in this section and its related forms only.

- C. New Product Documentation: For each new product in the Product Reporting Scope, submit the Material Content Form, with evidence of compliance attached.
- D. Product Cost Statement: Submit the total cost of all products defined as in the Product Reporting Scope, above, including purchase price, taxes, and delivery to site, but not labor, tools, or equipment for installation; submit prior to or along with initial application for payment; update and re-submit whenever the total cost changes due to contract modifications.

## **PART 2 PRODUCTS**

### **2.01 BASIC PRODUCT REQUIREMENTS**

- A. Composite Wood and Agrifiber Products: Provide products having no added urea-formaldehyde resins.
- B. Adhesives: Provide only products having lower volatile organic compound (VOC) content than required by SCAQMD Rule No. 1168.
- C. Miscellaneous:
  1. Building cavities shall be left clean and free of debris. All wall cavities shall be free of debris prior to installation of the gypsum board.
  2. All foodstuffs shall be disposed of in containers which will be removed from the job site and emptied at the end of each workday.
  3. All debris shall be removed from under and around the building premises and properly disposed of in a dumpster.
  4. The dumpster shall be removed when full on a regular basis so that piles of debris do not accumulate on the ground around it.
  5. Smoking is prohibited within or near any structure on the job site.
  6. The use of gas-generated machinery is to be minimized within or near the building after the foundation is completed.
  7. Heaters fueled by gasoline or kerosene are prohibited. If relative humidity rises above 55%, electric dehumidification should be applied until relative humidity remains consistently between 45% and 55% without additional dehumidification. Interior surface temperatures shall remain above 50 degrees. The joint compound must be completely dry before the application of primer.
  8. Provide construction ventilation with minimum 1.5 air changes per hour during the day of application and for two days afterwards:
    - a. For paints and adhesives.
    - b. For vinyl flooring and carpeting.
    - c. For any other materials and products that off-gas.
  9. Keep site, ducts and mechanical equipment and wall cavities clean.
  10. Clean duct system after painting and trim is completed.
  11. The contractor shall perform and maintain the special project procedures with the same quality of workmanship as would be expected with standard materials and methods. The contractor shall maintain a quality control program that ensures full protection of work against exposure to prohibited materials and practices.
  12. It is the responsibility of the general contractor to ensure that their labor force, all subcontractors and their labor forces, all suppliers, and other visitors be made aware of these rules and follow them at all times. The following sign is to be made and prominently posted on the job site. "This building/house is being constructed as a healthy building. Only specified products and procedures may be used. Alternatives to specified materials and products must be approved in writing by the owner and/or architect prior to use. If in doubt, contact the general contractor."
  13. Spills of fuels, solvents, or chemicals must be avoided. If a spill occurs, report it to the general contractor immediately.

14. Finish flooring materials shall not be applied over insufficiently cured concrete slabs. Quickly and thoroughly dry out precipitation that enters an unfinished structure. Wood members shall have a moisture content of less than 17%. Walls shall not be enclosed until wet applied insulation systems such as cellulose or spray foams are properly cured.
15. Provide MSDS sheets for paints and varnishing and maintain copy on site.

D. Materials:

1. All materials are to be protected from contamination and moisture damage during storage and after installation.
2. The contractor shall verify, prior to installation, that all materials are undamaged, uncontaminated, and free of acquired odors. Any products found to be defective shall not be used unless approved by the owner or architect.
3. The use of substances listed below is prohibited: Herbicides, fungicides, insecticides and other pesticides, except as specified.
  - a. Composite wood products containing urea-formaldehyde binders.
  - b. Commercial cleaning products other than those specified.
  - c. Adhesives, paints, sealers, stains, and other finishes except as specified.
  - d. Any building materials or components that have been contaminated while in storage or during shipment. An MSDS sheet and product literature must be provided on any substitution in order for it to be considered. Submit a physical sample to the owner or architect whenever possible.
4. No products may be substituted for the specified product unless agreed upon in writing by the owner or architect. An MSDS sheet and product literature must be provided on any substitution in order for it to be considered. Submit a physical sample to the owner or architect whenever possible.
5. Commercial Cleaning Products - Green Seal has recommended industrial and institutional cleaners that meet the following criteria:
  - a. Are not toxic to human or aquatic life.
  - b. Contain VOC levels under 10% by weight when diluted for use.
  - c. Are readily biodegradable.
  - d. Are not made of petrochemical compounds or petroleum.
  - e. Do not contain chlorine bleach.
  - f. Are free of phosphates and derivatives.
  - g. Do not contain phenolic compounds or glycol ethers.
  - h. Are free of arsenic, cadmium, chromium, lead, mercury, nickel, and selenium.
  - i. Have acceptable pH levels.
  - j. Work optimally at room temperatures.

## **PART 3 EXECUTION**

### **3.01 PROCEDURES**

- A. Submit sustainable design documentation by Contractor, using procedures defined under Submittals for Information in Section 01 3000.
- B. Submit sustainable design documentation to Architect, unless otherwise indicated.
- C. Where an item of sustainable design documentation is specified, fill out and submit the appropriate form.
  1. Fill out one form for each different brand name product and each different manufacturer of a lot of commodity products.
  2. Where required attachments are specified, attach the documentation to the back of the form.

3. Mark each blank with the appropriate information; use "ATT" for items attached; if any item is not relevant use the code "NR"; if any item is not available use the code "NA".
- D. Each form must be signed by the entity capable of certifying the information.
1. Certification signatures must be made by an officer of the company.
  2. For products, certification must be made by the manufacturer not the supplier.
  3. For custom fabricated products, certification by the fabricator is acceptable.
- E. Submit the completed forms in accordance with the requirements of Section 01 3000, as information submittals.
1. Give each form a unique submittal number.
  2. Do not combine sustainable design documentation with product data or shop drawing submittals.

**END OF SECTION**



# **SECTION 01 4000 - QUALITY REQUIREMENTS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Submittals.
- B. References and standards.
- C. Testing and inspection agencies and services.
- D. Control of installation.
- E. Mock-ups.
- F. Tolerances.
- G. Manufacturers' field services.
- H. Defect Assessment.

### **1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.
- B. Section 01 4533 - Code-Required Special Inspections.
- C. Section 01 6000 - Product Requirements: Requirements for material and product quality.

### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.
    - j. Conformance with Contract Documents.
    - k. When requested by Architect, provide interpretation of results.

2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
    1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
    2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
  - E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
  - F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
    1. Submit report in duplicate within 30 days of observation to Architect for information.
    2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
  - G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
    1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

#### **1.04 REFERENCES AND STANDARDS**

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

#### **1.05 Testing and Inspection Agencies and Services**

- A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.

- 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. Integrated Exterior Mock-ups: construct integrated exterior mock-up as indicated on Drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Notify Architect seven (7) working days in advance of dates and times when mock-ups will be constructed.
- E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- G. 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.

- H. Accepted mock-ups shall be a comparison standard for the remaining Work.
- I. 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-conformance of Work or products.
  - 6. Perform additional tests and inspections required by Architect.
  - 7. Attend preconstruction meetings and progress meetings.
  - 8. Submit reports of all tests/inspections specified.
  - 9. Submit a written report in binder form with an index at the conclusion of the work required by the Testing Agency. The report shall be submitted as a permanent record to the Owner, through the Structural Engineer, of all tests, logs, comments and written reports.
- 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 delivery of samples to testing laboratories.
    - e. 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. Each Prime Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.
  6. Each Prime Contractor and each agency engaged to perform inspections, tests, and similar services shall coordinate the sequence of activities to accommodate required services with minimal delay.
  7. Each Prime Contractor and each agency shall coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
  8. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  9. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing: The Contractor is responsible for re-testing where results of required inspections, tests, or similar services prove unsatisfactory or do not indicate compliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.
- F. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- G. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.
- H. The Contractor shall cooperate with agencies performing required inspections, tests, and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel.

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

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

### **3.06 DEFECT ASSESSMENT**

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

## **END OF SECTION**



# **SECTION 01 4533 - CODE-REQUIRED SPECIAL INSPECTIONS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Code-required special inspections.
- B. Testing services incidental to special inspections.
- C. Submittals.
- D. Manufacturers' field services.
- E. Fabricators' field services.

### **1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.
- B. Section 01 4000 - Quality Requirements.
- C. Section 01 6000 - Product Requirements: Requirements for material and product quality.

### **1.03 DEFINITIONS**

- A. Code or Building Code: ICC (IBC), 2015 Edition of the International Building Code and specifically, Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. National Institute of Standards and Technology (NIST).
- D. Special Inspection:
  - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
  - 2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

### **1.04 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- B. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2015ae1.
- C. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2014a.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.

- E. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
- F. ICC (IBC) - International Building Code; 2015.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency shall:
  - 1. Submit agency name, address, and telephone number, 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. Submit certification that Special Inspection Agency is acceptable to AHJ.
- C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
  - 1. 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. Submit certification that Testing Agency is acceptable to AHJ.
- D. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit two copies of report; one to Architect and one to the AHJ.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of Special Inspector.
    - d. Date and time of special inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of special inspection.
    - h. Date of special inspection.
    - i. Results of special inspection.
    - j. Conformance with Contract Documents.
  - 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- E. Test Reports: After each test or inspection, promptly submit two copies of report; one to Architect and one to AHJ.
  - 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 or inspection.
    - h. Date of test or inspection.



- i. Results of test or inspection.
  - j. Conformance with Contract Documents.
- F. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, in quantities specified for Product Data.
  - 1. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and AHJ.
- G. Manufacturer's Field Reports: Submit reports to Architect and AHJ.
  - 1. Submit report in duplicate within 30 days of observation to Architect for information.
  - 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- H. Fabricator's Field Reports: Submit reports to Architect and AHJ.
  - 1. Submit report in duplicate within 30 days of observation to Architect for information.
  - 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

#### **1.06 SPECIAL INSPECTION AGENCY**

- A. Owner will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

#### **1.07 TESTING AND INSPECTION AGENCIES**

- A. Owner may employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not required by the building code.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

#### **1.08 QUALITY ASSURANCE**

- A. Special Inspection Agency Qualifications:
  - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
- B. Testing Agency Qualifications:
  - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.

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

## **PART 3 EXECUTION**

### **3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL**

- A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
  - 1. Continuous Special Inspection: Special Inspection Agency shall be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspection: Special Inspection Agency shall be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

### **3.02 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION**

- A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved contract documents and ACI 318, Sections 3.5 and 7.1 through 7.7; periodic.
- B. Reinforcing Steel Welding: Verify compliance with AWS D1.4/D1.4M and ACI 318, Section 3.5.2; periodic.
- C. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved contract documents and ACI 318, Sections 8.1.3 and 21.2.8 prior to and during placement of concrete; continuous.
- D. Anchors Installed in Hardened Concrete: Verify compliance with ACI 318, Sections 3.8.6, 8.1.3, and 21.2.8; periodic.
- E. Design Mix: Verify plastic concrete complies with the design mix in approved contract documents and with ACI 318, Chapter 4 and 5.2; periodic.
- F. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M and ACI 318, Sections 5.6 and 5.8 and record the following, continuous:
  - 1. Slump.
  - 2. Air content.
  - 3. Temperature of concrete.
- G. Concrete and Shotcrete Placement: Verify application techniques comply with approved contract documents and ACI 318, Sections 5.9 and 5.10; continuous.
- H. Specified Curing Temperature and Techniques: Verify compliance with approved contract documents and ACI 318, Sections 5.11 through 5.13; periodic.
- I. Precast Concrete Members: Verify erection techniques and placement comply with approved contract documents and ACI 318, Chapter 16; periodic.
- J. Concrete Strength in Situ: Verify concrete strength complies with approved contract documents and ACI 318, Section 6.2, for the following.
  - 1. Prestressed members, prior to stressing of tendons; periodic.
  - 2. Beams and structural slabs, prior to removal of shores and forms; periodic.

- K. Formwork Shape, Location and Dimensions: Verify compliance with approved contract documents and ACI 318, Section 6.1.1; periodic.
- L. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials conform to the quality standards of ACI 318, the AHJ will require that the Special Inspector verify compliance with the appropriate standards and criteria in ACI 318, Chapter 3.

### **3.03 SPECIAL INSPECTIONS FOR SOILS**

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
  - 1. Design bearing capacity of material below shallow foundations; periodic.
  - 2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
  - 3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
  - 4. Subgrade, prior to placement of compacted fill; periodic.
- B. Testing: Classify and test excavated material; periodic.

### **3.04 OTHER SPECIAL INSPECTIONS**

- A. Provide for special inspection of work that, in the opinion of the AHJ, is unusual in nature.
- B. For the purposes of this section, work unusual in nature includes, but is not limited to:
  - 1. Construction materials and systems that are alternatives to materials and systems prescribed by the building code.
  - 2. Unusual design applications of materials described in the building code.
  - 3. Materials and systems required to be installed in accordance with the manufacturer's instructions when said instructions prescribe requirements not included in the building code or in standards referenced by the building code.
- C. Alternative Test Procedures: Where approved rules and standards do not exist, test materials and assemblies as required by AHJ or provide AHJ with documentation of quality and manner in which those materials and assemblies are used.

### **3.05 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES**

- A. Special Inspection Agency shall:
  - 1. Verify samples submitted by Contractor comply with the referenced standards and the approved contract documents.
  - 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 reference standards.
  - 4. Ascertain compliance of materials and products with requirements of Contract Documents.
  - 5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of work or products.
  - 6. Perform additional tests and inspections required by Architect.
  - 7. Attend preconstruction meetings and progress meetings.
  - 8. Submit reports of all tests or inspections specified.
- B. Limits on Special 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.
- C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

### **3.06 TESTING AGENCY DUTIES AND RESPONSIBILITIES**

- A. Testing Agency Duties:
1. Test samples submitted by Contractor.
  2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  3. Perform specified sampling and testing of products in accordance with specified standards.
  4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  5. Promptly notify Architect and Contractor of observed irregularities or non-conformance of work or products.
  6. Perform additional tests and inspections required by Architect.
  7. Attend preconstruction meetings and progress meetings.
  8. Submit reports of all tests or inspections specified.
- B. Limits on Testing or 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.
- C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

### **3.07 CONTRACTOR DUTIES AND RESPONSIBILITIES**

- A. Contractor Responsibilities, General:
1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
  2. Cooperate with agency and laboratory personnel; provide access to the work, to manufacturers' facilities, and to fabricators' facilities.
  3. Provide incidental labor and facilities:
    - a. To provide access to work to be tested or inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
    - c. To facilitate tests or 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 or inspection services.
  5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

### **3.08 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES**

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

**END OF SECTION**



# **SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Temporary telecommunications services.
- B. Temporary sanitary facilities.
- C. Temporary Controls: Barriers, enclosures, and fencing.
- D. Waste removal facilities and services.

### **1.02 RELATED REQUIREMENTS**

- A. Section 01 5813 - Temporary Project Signage.

### **1.03 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.

### **1.04 QUALITY ASSURANCE**

- A. Regulations: All contractors, sub-contractors, and suppliers shall comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to:
  - 1. Building code requirements.
  - 2. Health and safety regulations.
  - 3. Utility company regulations.
  - 4. Police Department, Fire Department, and Rescue Squad rules.
  - 5. Environmental protection regulations.
    - a. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.
- B. Standards: All contractors, sub-contractors, and suppliers shall comply with NFPA Code 241, "Building Construction and Demolition Operations," ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."
- C. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services," prepared by AGC and ASC for industry recommendations.
- D. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with the normal application of trade regulations and union jurisdictions.

- E. All contractors, sub-contractors, and suppliers shall provide new materials; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.
- F. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.
- G. Lumber and Plywood: Comply with requirements in Section 06 1000 - Rough Carpentry.
- H. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electrical service. Install service in compliance with the National Electrical Code (NFPA 70).
- I. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures, construction operations, and similar elements.
- J. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

#### **1.05 TEMPORARY UTILITIES**

- A. Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
- B. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
- C. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
- D. Obtain easements to bring utilities to the site, where the Owner's easements cannot be used for that purpose.
- E. Cost or use charges for temporary facilities are not chargeable to the Owner or Architect; Prime Contractor's cost or use charges for temporary services or facilities will not be accepted as a basis of claim for an adjustment in the Contract Sum or Contract Time.
- F. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- G. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Sitework Divisions and Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.
- H. Water: Provide potable water approved by local health authorities.
  - 1. Water service and distribution: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.
  - 2. Sterilization: Sterilize temporary water piping prior to use.
  - 3. Water supply may only be interrupted on a weekend for changing over to the new service.
- I. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry



wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off the site in a lawful manner.

1. Connect temporary sewers to the municipal system as directed by the sewer department officials.
  2. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.
  3. Filter out excessive amounts of soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
  4. Temporary holding tanks and pumps will be required for both storm and sanitary sewer where existing services exit the present building in to the construction zone.
- J. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
- K. Temporary Heat:
1. Provide temporary heat required by construction activities, for curing or drying of completed installations, or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
  2. Temporary heat shall not be directly fired into the space, or have exhaust gases discharged into the tempered space. The contractor providing temporary heating facilities shall be responsible for complying with all workplace health requirements. Use of gasoline-burning space heaters, or open burning or salamander type heating units is prohibited.
- L. Heating Facilities: Provide properly vented self-contained LP gas or fuel oil heaters with individual space thermostatic control. Combustion gases shall be vented to the exterior. The permanent system shall not be used for temporary heat.
- M. Temporary Electric Power:
1. Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.
  2. Power panels shall be 100A, 120/240V loadcenter or panelboards with NEMA AB1 type molded case circuit breakers. Panelboards shall be provided for use by all trades. Receptacles shall be equivalent to those specified in Division 26 Sections. Provide properly configured NEMA polarized outlets to prevent insertion of 125 volt AC plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment. Power receptacles shall include three duplex 20A, 125V, single phase, and one 50A 125/250V, single phase located on a plywood backboard with the temporary panel. Receptacles shall be provided at intervals and locations as required for legal use of extension cords.
- N. Temporary Electric Lights:
1. Whenever an overhead floor or roof deck has been installed, install temporary lighting with local switching.
  2. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire lighting system, and will provide adequate illumination for construction operations and traffic conditions.
  3. Contractor shall provide and maintain the equivalent illumination of one 100 watt incandescent fixture per 150 square feet of space (minimum one), as strings of lighting with guards, the full length of each corridor or interior construction route, and floodlighting for all exterior excavation

areas. Every other stringer fixture and floodlighting shall be circuited and controlled by circuit breakers located in temporary power panels.

4. Lamps and Light Fixtures: Provide rough service lamps. Provide guard cages or tempered glass enclosures. Provide weatherproof quartz exterior fixtures.
5. Under no conditions shall the permanent lighting fixtures be used for temporary lighting, unless approved in writing obtained from the Architect/Engineer upon consultation with the Owner.

#### **1.06 TELECOMMUNICATIONS SERVICES**

- A. Each Contractor is responsible for their own cellular phone service.
- B. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

#### **1.07 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.
- C. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Projects's needs.
- D. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility.

#### **1.08 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. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public, of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.
- D. Provide protection for plants designated to remain. Replace damaged plants.
- E. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

#### **1.09 FENCING**

- A. Site Fencing:
  1. Construction: Commercial grade chain link fence.
  2. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.
- B. Tree Protection Fencing
  1. Provide 4 foot high orange polypropylene fencing located at the canopy line / drip line of trees on the site to protect trunks from damage and soil compaction around the root area.

2. Posts are contractor's option
- C. Maintain the fences in good secure condition for the project's duration until agreement with the Owner and Architect that it may be removed.

#### **1.10 EXTERIOR ENCLOSURES**

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- B. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hours a day basis where required to achieve indicated results and to avoid possibility of damage.

#### **1.11 INTERIOR ENCLOSURES**

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:
  1. Insulated to R 12 (RSI 2.1).
  2. STC rating of 35 in accordance with ASTM E90.
  3. Maximum flame spread rating of 25 in accordance with ASTM E84.
  4. Interior protection barriers and walls shall be constructed using 5/8" type X gypsum board each side of 3-5/8 inch minimum thickness metal stud framing.
  5. Doors between construction and occupied spaces shall be self closing, and self latching.

#### **1.12 SECURITY AND SAFETY**

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.
- C. First Aid Supplies: Comply with regulation of authorities having jurisdiction.
- D. Temporary Fire Protection
  1. Fire Extinguishers: Provide hand-carried, portable, UL-rated, class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, class ABC dry chemical extinguishers, or a combination of extinguishers of NFPA recommended types for the exposures.
  2. Comply with NFPA 10 and 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
  3. Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."
  4. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

- E. Store combustible materials in containers in fire-safe locations. Remove from construction site daily.
- F. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.
- G. Provide continuous supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
- H. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer as requested by the Architect.
- I. Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished permanent stairs with a protective covering of plywood or similar materials so finishes will be undamaged at the time of acceptance.

### **1.13 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. Designated existing on-site roads may be used for construction traffic.
- F. Coordinate temporary parking areas to accommodate construction personnel with Owner. When site space is not adequate, provide additional off-site parking.

### **1.14 WASTE REMOVAL**

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.
- F. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste.

### **1.15 PROJECT SIGNS - See Section 01 5813**

### **1.16 FIELD OFFICES**

- A. Maintain field offices and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities under conditions acceptable to the Owner.
- B. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture .
- C. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- D. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

### **1.17 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 (600 mm). Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Termination and Removal: Unless the Architect requests it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, but no later than Substantial Completion. Complete, or if necessary restore, permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace Work which cannot be satisfactorily repaired.
- E. Materials and facilities that constitute temporary facilities are property of each prime Contractor.
- F. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
  - 1. Replace air filters and clean inside of ductworks and housings.
  - 2. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
  - 3. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.
- G. Restore existing facilities used during construction to original condition.

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

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

## **END OF SECTION**



# **SECTION 01 5721 - INDOOR AIR QUALITY CONTROLS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Construction procedures to promote adequate indoor air quality after construction.
- B. Building flush-out after construction and before occupancy.
- C. Testing indoor air quality after completion of construction.
- D. Testing air change effectiveness after completion of construction.
- E. Testing residential unit air isolation.

### **1.02 PROJECT GOALS**

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

### **1.03 RELATED REQUIREMENTS**

- A. Section 01 3329 - Green Building Requirements.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

### **1.04 REFERENCE STANDARDS**

- A. ASHRAE Std 129 - Measuring Air-Change Effectiveness; 1997 (Reaffirmed 2002).
- B. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology); 2009.
- C. ASTM E779 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization; 2010.
- D. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health; v1.1, 2010.
- E. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air; April 1990.

- F. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; Jan-99.
- G. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction; 2007.

#### **1.05 DEFINITIONS**

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

#### **1.06 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
  - 1. Submit not less than 60 days before enclosure of building.
  - 2. Identify potential sources of odor and dust.
  - 3. Identify construction activities likely to produce odor or dust.
  - 4. Identify areas of project potentially affected, especially occupied areas.
  - 5. Evaluate potential problems by severity and describe methods of control.
  - 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
  - 7. Describe cleaning and dust control procedures.
- C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- D. Duct and Terminal Unit Inspection Report.
- E. Air Contaminant Test Plan: Identify:
  - 1. Testing agency qualifications.
  - 2. Locations and scheduling of air sampling.
  - 3. Test procedures, in detail.
  - 4. Test instruments and apparatus.
  - 5. Sampling methods.
- F. Air Contaminant Test Reports: Show:
  - 1. Location where each sample was taken, and time.
  - 2. Test values for each air sample; average the values of each set of 3.
  - 3. HVAC operating conditions.
  - 4. Certification of test equipment calibration.
  - 5. Other conditions or discrepancies that might have influenced results.



- G. Ventilation Effectiveness Test Plan: Identify:
  - 1. Testing agency qualifications.
  - 2. Description of test spaces, including locations of air sampling.
  - 3. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
  - 4. Test instruments and apparatus; identify tracer gas to be used.
  - 5. Sampling methods.
  
- H. Ventilation Effectiveness Test Reports: Show:
  - 1. Include preliminary tests of instruments and apparatus and of test spaces.
  - 2. Calculation of ventilation effectiveness, E.
  - 3. Location where each sample was taken, and time.
  - 4. Test values for each air sample.
  - 5. HVAC operating conditions.
  - 6. Other information specified in ASHRAE Std 129.
  - 7. Other conditions or discrepancies that might have influenced results.
  
- I. Residential Units Air Isolation Test Plan: Identify:
  - 1. Testing agency qualifications.
  - 2. Description of test spaces, including locations of air sampling.
  - 3. Test procedures, in detail.
  - 4. Test instruments and apparatus; identify tracer gas to be used.
  - 5. Sampling methods.
  
- J. Residential Units Air Isolation Reports: Show:
  - 1. Include preliminary tests of instruments and apparatus.
  - 2. Include inspection of membrane seals in test spaces.
  - 3. HVAC operating conditions.
  - 4. Location where each sample was taken, and time.
  - 5. Test values for each air sample.
  - 6. Other information specified in ASHRAE Std 129.
  - 7. Other conditions or discrepancies that might have influenced results.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.

## **PART 3 EXECUTION**

### **3.01 CONSTRUCTION PROCEDURES**

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
  - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
  - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
  - 3. Provide sufficient ventilation for drying within reasonable time frame.
  
- B. Begin construction ventilation when building is substantially enclosed.
  
- C. Do not store construction materials or waste in mechanical or electrical rooms.

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

### **3.02 BUILDING FLUSH-OUT**

- A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
- B. Perform building flush-out before occupancy.
- C. Do not start flush-out until:
  - 1. All construction is complete.
  - 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
  - 3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
  - 4. New HVAC filtration media have been installed.
- D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot (4500 cubic meters per square meter) of floor area has been supplied.
  - 1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
  - 2. Maintain interior temperature of at least 60 degrees F (15 degrees C) and interior relative humidity no higher than 60 percent.
  - 3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
  - 4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
    - a. Begin ventilation at least three hours prior to daily occupancy.
    - b. Continue ventilation during all occupied periods.
    - c. Provide minimum outside air volume of 0.30 cfm per square foot (0.0015 cu m/s/sq m) or design minimum outside air rate, whichever is greater.
- E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

### **3.03 AIR CONTAMINANT TESTING**

- A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.
- B. Perform air contaminant testing before occupancy.

- C. Do not start air contaminant testing until:
  1. All construction is complete, including interior finishes.
  2. HVAC systems have been tested, adjusted, and balanced for proper operation.
  3. New HVAC filtration media have been installed.
  
- D. Indoor Air Samples: Collect from spaces representative of occupied areas:
  1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
  2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet (2300 square meters); take samples from areas having the least ventilation and those having the greatest presumed source strength.
  3. Collect samples from height from 36 inches (915 mm) to 72 inches (1830 mm) above floor.
  4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
  5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
  6. When retesting the same building areas, take samples from at least the same locations as in first test.
  
- E. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.
  
- F. Analyze air samples and submit report.
  
- G. Air Contaminant Concentration Limits:
  1. Formaldehyde: Not more than 27 parts per billion.
  2. PM10 Particulates: Not more than 50 micrograms per cubic meter.
  3. Total Volatile Organic Compounds (TVOCs): Not more than 500 micrograms per cubic meter.
  4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: Allowable concentrations listed in Table 4-1.
  5. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.
  
- H. Air Contaminant Concentration Test Methods:
  1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6.
  2. Particulates: EPA 600/4-90/010 Method IP-10.
  3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
  4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
  5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.

### **3.04 VENTILATION EFFECTIVENESS TESTING**

- A. Perform ventilation effectiveness testing before occupancy.
  
- B. Do not begin ventilation effectiveness testing until:
  1. HVAC testing, adjusting, and balancing has been satisfactorily completed.
  2. Building flush-out or air contaminant testing has been completed satisfactorily.
  3. New HVAC filtration media have been installed.

- C. Test each air handler zone in accordance with ASHRAE Std 129.
- D. If calculated air change effectiveness for a particular zone is less than 0.9 due to inadequate balancing of the system, adjust, and retest at no cost to Owner.

### **3.05 RESIDENTIAL UNITS AIR ISOLATION TESTING**

- A. Residential units have been designed to have an airtight sealed membrane between units; inspect membrane seal at the following locations and repair as required:
  - 1. Between party walls and floor structure.
  - 2. Between party walls and roof structure.
  - 3. Around pipes, conduits, and ducts passing through floors and party walls.
- B. Airtight membrane has been designed to limit leakage area to less than 1.25 square inches (806 square mm) per 100 square feet (square meter) of wall, ceiling, and floor area.
- C. If possible, perform inspection and testing prior to covering up air seals in walls and floors.
- D. Otherwise, perform testing after completion of construction but before occupancy.
- E. Test airtight membrane in accordance with ASTM E779 or other appropriate method.
- F. Acceptable Results: Maximum leakage of 0.23 cubic feet per minute per square foot (1.17 liters per second per square meter) at 1.1 pounds per square foot (50 Pa) pressure .
- G. If test results show excess leakage area, reinspect, repair, and retest.
- H. Test differential pressure between residential unit and pressurized hallway:
  - 1. With the entrance door closed, operate the ventilation system in normal manner.
  - 2. Take pressure readings for 15 minutes, with minimum of one measurement every 10 seconds.

### **END OF SECTION**

# **SECTION 01 5813 - TEMPORARY PROJECT SIGNAGE**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Project identification sign.

### **1.02 QUALITY ASSURANCE**

- A. Design sign and structure to withstand 50 miles/hr (80 km/hr) wind velocity.
- B. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

## **PART 2 PRODUCTS**

### **2.01 SIGN MATERIALS**

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch (19 mm) thick, standard large sizes to minimize joints.
- C. Sign Media: Sintra PVC foam board or approved equal product.

### **2.02 PROJECT IDENTIFICATION SIGN**

- A. One printed sign of construction, design, and content shown on Drawings, location designated.
- B. Size: 8 feet high by 12 feet wide.
- C. Graphics for the sign will be provided in electronic format by the Architect. Contractor shall have the graphic printed on the specified sign media.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

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

### **3.02 MAINTENANCE**

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

### **3.03 REMOVAL**

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

**END OF SECTION**

# **SECTION 01 6000 - PRODUCT REQUIREMENTS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

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

### **1.02 RELATED REQUIREMENTS**

- A. Section 00 2600 - Procurement Substitution Requirements: Requests for substitution during the bidding process.
- B. Section 01 2500 - Substitution Procedures: Substitutions made during and after the Bidding/Negotiation Phase.
- C. Section 01 4000 - Quality Requirements: Product quality monitoring.
- D. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

### **1.03 DEFINITIONS**

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well recognized meanings in the construction industry.
  - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 2. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
  - 3. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form a part of the Work.
  - 4. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

### **1.04 SUBMITTALS**

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
  - 1. Submit within 30 days after date of Agreement.
  - 2. For products specified only by reference standards, list applicable reference standards.

- B. 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.
- C. 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.
- D. 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.

### **1.05 QUALITY ASSURANCE**

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
- B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
  - 1. Each prime Contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate Contractors.
  - 2. If a dispute arises between prime Contractors over concurrently selectable, but incompatible products, the Architect will determine which products shall be retained and which are incompatible and must be replaced.
- C. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.
- D. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
- E. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
  - 1. Name of product and manufacturer.
  - 2. Model and serial number.
  - 3. Capacity.
  - 4. Speed.
  - 5. Ratings.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT SELECTION**

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.
  - 1. Provide products complete with all accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect.



2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:
1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
  2. Semiproprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.
    - a. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Documents provisions concerning "substitutions" to obtain approval for use of an unnamed product.
  3. Descriptive Specification Requirements: Where specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
  4. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.
    - a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
  5. Compliance with Standards, Codes, and Regulations: Where the Specifications only require compliance with an imposed code, standard, or regulation select a product that complies with the standards, codes, or regulations specified.
  6. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
  7. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern, and texture from the product line selected.

## 2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. DO NOT USE products having any of the following characteristics:
  1. Made using or containing CFC's or HCFC's.
  2. Made of wood from newly cut old growth timber.
  3. Containing lead, cadmium, asbestos.
- C. Where all other criteria are met, Contractor shall give preference to products that:
  1. If used on interior, have lower emissions, as defined in Section 01 6116.
  2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
  3. Are extracted, harvested, and/or manufactured closer to the location of the project.
  4. Have longer documented life span under normal use.
  5. Result in less construction waste.
  6. Are made of vegetable materials that are rapidly renewable.
  7. Are made of recycled materials.
  8. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
  9. Have a published GreenScreen Chemical Hazard Analysis.

### **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 2500 - 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. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- 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. Prevent contact with material that may cause corrosion, discoloration, or staining.
- L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

#### **3.05 INSTALLATION OF PRODUCTS**

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
- B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

### **END OF SECTION**



# **SECTION 01 6116 - VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Requirements for VOC-Content-Restricted products.

### **1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.
- B. Section 01 4000 - Quality Requirements: Procedures for testing and certifications.
- C. Section 01 6000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

### **1.03 DEFINITIONS**

- A. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings.
  - 2. Interior adhesives and sealants, including flooring adhesives.
  - 3. Wet-applied roofing and waterproofing.
  - 4. Other products when specifically stated in the specifications.
- B. Interior of Building: Anywhere inside the exterior weather barrier.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

### **1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2013).
- C. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; California Air Resources Board; current edition.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- E. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.

- G. SCS (CPD) - SCS Certified Products; current listings at [www.scs-certified.com](http://www.scs-certified.com).

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

#### **1.06 QUALITY ASSURANCE**

- A. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
    - b. Published product data showing compliance with requirements.
- B. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current SCS "No Added Formaldehyde (NAF)" certification; [www.scs-certified.com](http://www.scs-certified.com).
    - b. Report of laboratory testing performed in accordance with requirements.
    - c. Published product data showing compliance with requirements.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. VOC-Content-Restricted Products: VOC content not greater than required by the following:
  - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  - 2. Joint Sealants: SCAQMD 1168 Rule.
  - 3. Paints and Coatings: Each color; most stringent of the following:
    - a. 40 CFR 59, Subpart D.
    - b. SCAQMD 1113 Rule.
    - c. CARB (SCM).
  - 4. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

### **PART 3 EXECUTION**

#### **3.01 FIELD QUALITY CONTROL**

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

### **END OF SECTION**

# **SECTION 01 7000 - 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. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- J. General requirements for maintenance service.

### **1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 3000 - Administrative Requirements: Submittals procedures.
- C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- D. Section 01 5000 - Temporary Facilities and Controls: Temporary exterior enclosures.
- E. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.
- F. Section 01 7419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- G. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.
- H. Section 07 8400 - Firestopping.

### **1.03 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.
- D. Project Record Documents:
  - 1. Contractor shall provide a final as-built survey completed by an ALTA land surveyor.
  - 2. Accurately record actual locations of capped and active utilities.

#### **1.05 QUALIFICATIONS**

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

- A. See Section 01 1000 for occupancy-related requirements.
- B. 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.
- C. Notify affected utility companies and comply with their requirements.
- D. 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.
- E. 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.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.



- H. 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 6000 - 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 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.

- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.04 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, ground floor elevations.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

### **3.05 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.

### 3.06 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. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction indicated on drawings.
  
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
  - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
  - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
  
- D. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
  - 2. Remove items indicated on drawings.
  - 3. Relocate items indicated on drawings.
  - 4. 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.
  - 5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
  
- E. 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. See Section 01 1000 for other limitations on outages and required notifications.
    - c. 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.
  
- F. 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.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
  2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
  3. Where a change of plane of 1/4 inch (6 mm) or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
  4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.
- H. 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.
- I. 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.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

### **3.07 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-conforming 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 skilled and experienced 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 8400, 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.

### **3.08 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.

### **3.09 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.

### **3.10 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.

- B. Notify Architect and owner seven days prior to start-up of each item.
- C. 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.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.11 DEMONSTRATION AND INSTRUCTION**

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.
- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

### **3.12 ADJUSTING**

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

### **3.13 FINAL CLEANING**

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.14 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
- 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.

### **3.15 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION**



# SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

## PART 1 GENERAL

### 1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
  - 1. Aluminum and plastic beverage containers.
  - 2. Corrugated cardboard.
  - 3. Wood pallets.
  - 4. Clean dimensional wood: May be used as blocking or furring.
  - 5. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
- E. Methods of trash/waste disposal that are not acceptable are:
  - 1. Burning on the project site.
  - 2. Burying on the project site.
  - 3. Dumping or burying on other property, public or private.
  - 4. Other illegal dumping or burying.
- F. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

### 1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

## **PART 2 PRODUCTS**

### **2.01 PRODUCT SUBSTITUTIONS**

- A. See Section 01 6000 - Product Requirements for substitution submission procedures.
- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 6000:
  - 1. Relative amount of waste produced, compared to specified product.
  - 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
  - 3. Proposed disposal method for waste product.
  - 4. Markets for recycled waste product.

## **PART 3 EXECUTION**

### **3.01 WASTE MANAGEMENT PROCEDURES**

- A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

- D. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

### **3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION**

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
  - 1. Pre-bid meeting.
  - 2. Pre-construction meeting.
  - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  - 1. Provide containers as required.
  - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

### **END OF SECTION**



## **SECTION 01 7800 - 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 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - 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. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
  - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
  - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
  - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
  - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
  - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

### **PART 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. Specifications.
  3. Addenda.
  4. Change Orders and other modifications to the Contract.
  5. Reviewed shop drawings, product data, and samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates utilized.
  3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  3. Field changes of dimension and detail.
  4. 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.
  2. Information for re-ordering custom manufactured products.
- 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. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. 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 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 (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. 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.
- J. Arrangement of Contents: Organize each volume in parts as follows:
  - 1. Project Directory.
  - 2. Table of Contents, of all volumes, and of this volume.
  - 3. Operation and Maintenance Data: Arranged by system, then by product category.
    - a. Source data.
    - b. Product data, shop drawings, and other submittals.
    - c. Operation and maintenance data.
    - d. Field quality control data.
    - e. Photocopies of warranties and bonds.
  - 4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

5. Provide a manual on emergency operations targeted toward operations and maintenance staff and other building-level personnel.

### **3.05 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.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

### **END OF SECTION**



## **SECTION 03 2000 - CONCRETE REINFORCING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

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

#### **1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete.

#### **1.03 REFERENCE STANDARDS**

- A. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- B. ACI SP-66 - ACI Detailing Manual; 2004.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- E. CRSI (DA4) - Manual of Standard Practice; 2009.

#### **1.04 SUBMITTALS**

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

#### **1.05 QUALITY ASSURANCE**

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

### **PART 2 PRODUCTS**

#### **2.01 REINFORCEMENT**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
  - 1. Deformed billet-steel bars.
  - 2. Unfinished.

- B. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064/A1064M.
  - 1. Form: Flat Sheets.
- C. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch (1.29 mm).
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
  - 3. Provide stainless steel components for placement within 1-1/2 inches (38 mm) of weathering surfaces, unless noted otherwise on Structural drawings. Wood materials are prohibited.

## **2.02 FABRICATION**

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is not permitted.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.
  - 1. Review locations of splices with Structural Engineer.

## **PART 3 EXECUTION**

### **3.01 PLACEMENT**

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
  - 1. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- B. Do not cut, puncture, displace or damage vapor barrier. Repair damage and reseal vapor retarder before placing concrete.
- C. Accommodate placement of formed openings.
- D. Conform to applicable code for concrete cover over reinforcement.
- E. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

### **3.02 FIELD QUALITY CONTROL**

- A. An independent testing agency, as specified in Section 01 4000, will inspect installed reinforcement for conformance to contract documents before concrete placement.

## **END OF SECTION**

## **SECTION 03 3000 - CAST-IN-PLACE CONCRETE**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Concrete formwork.
- B. Floors and slabs on grade.
- C. Concrete foundation walls.
- D. Joint devices associated with concrete work.
- E. Miscellaneous concrete elements, including equipment pads.
- F. Concrete curing.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 03 2000 - Concrete Reinforcing.
- B. Section 03 3511 - Concrete Floor Finishes: Densifiers, hardeners, applied coatings, and polishing.
- C. Section 07 9200 - Joint Sealants: Products and installation for sealants for saw cut joints and isolation joints in slabs.

#### **1.03 REFERENCE STANDARDS**

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- C. ACI 301 - Specifications for Structural Concrete; 2010 (Errata 2012).
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; 2004 (Errata 2007).
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- F. ACI 305R - Hot Weather Concreting; 2010.
- G. ACI 306R - Cold Weather Concreting; 2010.
- H. ACI 308R - Guide to Curing Concrete; 2001 (Reapproved 2008).
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- J. ACI 347R - Guide to Formwork for Concrete; 2014.
- K. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- L. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.

- M. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- N. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- O. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.
- P. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- Q. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- R. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.
- S. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete; 2010a (Reapproved 2015).
- T. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- U. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.
- V. 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; 2011.
- W. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.
- X. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).
- Y. NSF 372 - Drinking Water System Components - Lead Content; 2011.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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.
- C. Mix Design: Submit proposed concrete mix design.
  - 1. Employ an independent testing laboratory to test proposed aggregate and design concrete mixes for each type of concrete required.
  - 2. Submit aggregate test reports and mix designs for approval 14 days prior to placing concrete.
  - 3. Test each type of fine and coarse aggregate for conformance to ASTM C33-78.
  - 4. Design mixes in accordance with ACI 301, Section 3.8.2, Method 1 or Method 2.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

- F. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

### **1.05 QUALITY ASSURANCE**

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.

## **PART 2 PRODUCTS**

### **2.01 FORMWORK**

- A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
  - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
  - 2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
  - 3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
  - 4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches (38 mm) of concrete surface.

### **2.02 REINFORCEMENT**

- A. Comply with requirements of Section 03 2000.

### **2.03 CONCRETE MATERIALS**

- A. Cement: ASTM C150/C150M, Type I/II Portland type, unless noted otherwise in Structural Drawings.
- B. Fine and Coarse Aggregates: ASTM C 33.
  - 1. Acquire all aggregates for entire project from same source.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: Clean and not detrimental to concrete.
- E. Fiber Reinforcement: ASTM C1116/C1116M.
  - 1. Fiber Type: Alkali-resistant synthetic.

### **2.04 ADMIXTURES**

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

## 2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder <VPR RET-2>: Multi-layer, fabric-, cord-, grid-, or aluminum-reinforced polyethylene or equivalent, complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.
1. Installation: Comply with ASTM E1643.
  2. Permeance of less than 1.0 perms as tested in accordance with ASTM E 1745.
  3. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations in vapor retarder.
  4. Manufacturers:
    - a. Insulation Solutions, Inc; Viper VaporCheck II 10-mil (Class A): [www.insulationsolutions.com/#sle](http://www.insulationsolutions.com/#sle).
    - b. Stego Industries, LLC; Stego Wrap Vapor Barrier (10-mil): [www.stegoindustries.com](http://www.stegoindustries.com).
    - c. W.R. Meadows, Inc.; PERMINATOR Class A - 10 mils (0.25 mm): [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
    - d. Raven Industries; VaporBlock VB 10: [www.ravenefd.com](http://www.ravenefd.com).
    - e. Poly-America; Husky Yellow Guard 10 mil (Class A): [www.yellowguard.com](http://www.yellowguard.com).
    - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
1. Grout: Comply with ASTM C1107/C1107M.
  2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch (13.7 MPa).
  3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch (48 MPa).

## 2.06 BONDING AND JOINTING PRODUCTS

- A. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
1. Configuration: As indicated on drawings.
  2. Size: As indicated on drawings.
- B. Slab Isolation Joint Filler: 1/2 inch (13 mm) thick, height equal to slab thickness, with removable top section that will form 1/2 inch (13 mm) deep sealant pocket after removal.
1. Material: ASTM D1751, cellulose fiber.
- C. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with minimum 1 inch (25 mm) diameter holes for conduit or rebars to pass through at 6 inches (150 mm) on center; ribbed steel stakes for setting.

## 2.07 CURING MATERIALS

- A. Curing and Sealing Compound, Low Gloss <CONC SLR-1>: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.
1. Apply in accordance with manufacturer's instructions during concrete curing.
  2. Near Substantial Completion, apply a final coat(s) to produce a consistent, uniform low gloss finish to floor areas indicated to receive <CONC SLR-1>.
  3. Solids by Mass: 25 percent, minimum.
  4. Manufacturers:
    - a. Dayton Superior Corporation; Cure & Seal 1315 J22WB: [www.daytonsuperior.com](http://www.daytonsuperior.com).
    - b. W.R. Meadows, Inc.; VOCOMP-25: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).

- c. BASF; Kure 1315: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com).
  - d. Scofield; Cureseal-W: [www.scofield.com](http://www.scofield.com).
  - e. Substitutions: See Section 01 6000 - Product Requirements.
- B. Moisture-Retaining Sheet: ASTM C171.
- 1. Curing paper, regular.
  - 2. White-burlap-polyethylene sheet, weighing not less than 10 ounces per linear yard, 40 inches wide (305 g/sq m).
- C. Polyethylene Film: ASTM D2103, 4 mil (0.1 mm) thick, clear.
- D. Water: Potable, not detrimental to concrete.

## **2.08 CONCRETE MIX DESIGN**

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- C. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard (0.89 kg per cubic meter), or as recommended by manufacturer for specific project conditions.

## **2.09 MIXING**

- A. Transit Mixers: Comply with ASTM C94/C94M.

## **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 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

### **3.03 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. 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.
- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

### **3.04 SLAB JOINTING**

- A. Locate joints as indicated on the 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.
  - 1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.
- E. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

### **3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES**

- A. Maximum Variation of Surface Flatness:
  - 1. Exposed Concrete Floors: 1/4 inch (6 mm) in 10 feet (3 m).
  - 2. Under Seamless Resilient Flooring: 1/4 inch (6 mm) in 10 feet (3 m).
  - 3. Under Carpeting: 1/4 inch (6 mm) in 10 feet (3 m).
- 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.

### **3.06 CONCRETE FINISHING**

- A. Repair surface defects, including tie holes, immediately after removing formwork.



- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch (6 mm) or more in height. Provide finish as follows:
  - 1. Smooth Rubbed Finish <CONC FIN-11>: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. Concrete Slabs <CONC FIN-1>: Finish to requirements of ACI 302.1R, and as follows:
  - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI 302.1R; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
  - 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI 302.1R; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
  - 3. Decorative Exposed Surfaces: Trowel as described in ACI 302.1R; use steel-reinforced plastic trowel blades instead of steel blades to avoid black-burnish marks; decorative exposed surfaces include surfaces to be stained or dyed, pigmented concrete, surfaces to receive liquid hardeners, surfaces to receive dry-shake hardeners, surfaces to be polished, and all other exposed slab surfaces.
- E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:50 nominal, unless noted otherwise in the drawings.

### **3.07 CURING AND PROTECTION**

- A. Comply with requirements of ACI 308R. 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.
    - a. Spraying: Spray water over floor slab areas and maintain wet.
    - b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
  - 3. Final Curing: Begin after initial curing but before surface is dry.
    - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches (75 mm) 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.

### **3.08 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - 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. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

### **3.09 DEFECTIVE CONCRETE**

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- 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.

### **3.10 PROTECTION**

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

## **END OF SECTION**

# **SECTION 03 4100 - PRECAST STRUCTURAL CONCRETE**

## **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. Precast structural concrete.
- B. Related Requirements:
  - 1. Section 03 3000 "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
  - 2. Section 05 5000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.

### **1.03 DEFINITIONS**

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Architect.

### **1.04 PREINSTALLATION MEETINGS**

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

### **1.05 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.
- C. Shop Drawings:
  - 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
  - 2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
  - 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
  - 4. Indicate separate face and backup mixture locations and thicknesses.
  - 5. Indicate type, size, and length of welded connections by AWS standard symbols.
  - 6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
  - 7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
  - 8. Include and locate openings larger than 10 inches. Where additional structural support is required, include header design.
  - 9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
  - 10. Indicate relationship of precast structural concrete units to adjacent materials.
  - 11. Indicate locations, dimensions, and details of thin-brick units, including corner units and special shapes, and joint treatment.

12. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
  13. Indicate estimated camber for precast floor slabs with concrete toppings.
  14. Indicate shim sizes and grouting sequence.
  15. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Show precast structural concrete unit types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast structural concrete.

#### **1.06 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer, fabricator, testing agency.
- B. Welding certificates.
- C. Material Test Reports: For aggregates, by a qualified testing agency.
- D. Preconstruction test reports.
- E. Source quality-control reports.
- F. Field quality-control and special inspection reports.

#### **1.07 QUALITY ASSURANCE**

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  1. Designated as a PCI-certified plant as follows:
    - a. Group C, Category C2 - Prestressed Hollowcore and Repetitively Produced Products, Category C3 - Prestressed Straight Strand Structural Members Category, C4 - Prestressed Deflected Strand Structural Members.
- B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S1 - Simple Structural Systems.
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- D. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

## **1.08 COORDINATION**

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

## **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
  - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
  - 2. Place adequate dunnage of even thickness between each unit.
  - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Approved Manufacturers
  - 1. Molin Concrete Products
  - 2. Wells Concrete
  - 3. Gage Brothers Concrete Products
  - 4. County Materials Coporation

### **2.02 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design precast structural concrete units.
- B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- C. Fire-Resistance Calculations: Where indicated, provide precast structural concrete units whose fire resistance meets prescriptive requirements of authorities having jurisdiction or has been calculated according to ACI 216.1 and PCI MNL 124, "Design for Fire Resistance of Precast Prestressed Concrete," and is acceptable to authorities having jurisdiction.
- D. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
- E. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the design loads as indicated on structural drawings within limits and under conditions indicated:
  - 1. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load

deflection, shrinkage and creep of primary building structure, and other building movements.  
Maintain precast structural concrete deflections within limits of ACI 318.

2. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

### **2.03 MOLD MATERIALS**

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
  1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying setting of newly placed concrete mixture to depth of reveal specified.

### **2.04 REINFORCING MATERIALS**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, with ASTM A 767/A 767M, Class II zinc coating and chromate treatment. Galvanize after fabrication and bending.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- E. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M or ASTM A 1064/A 1064M, flat sheet.
- H. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain, flat sheet, Type 1 bendable coating.
- I. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

### **2.05 PRESTRESSING TENDONS**

- A. Pretensioning Strand: ASTM A 416/A 416M, Grade 250 or Grade 270, uncoated, seven-wire or ASTM A 886/A 886M, Grade 270, indented, seven-wire, low-relaxation strand.

- B. Unbonded Post-Tensioning Strand: ASTM A 416/A 416M, Grade 270, uncoated, seven-wire, low-relaxation strand.
  - 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.
- C. Post-Tensioning Bars: ASTM A 722/A 722M, uncoated high-strength steel bar.

## 2.06 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.
  - 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
  - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
  - 2. Metakaolin: ASTM C 618, Class N.
  - 3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
  - 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 5. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IS, portland blast-furnace slag Type IP, portland-pozzolan Type I (PM), pozzolan-modified portland Type I (SM), slag-modified portland cement.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33/C 33M. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- D. Lightweight Aggregates: Except as modified by PCI MNL 116, ASTM C 330/C 330M, with absorption less than 11 percent.
- E. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- G. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
  - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
  - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 7. Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
  - 8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
  - 9. Corrosion-Inhibiting Admixture: ASTM C 1582/C 1582M.

## **2.07 STEEL CONNECTION MATERIALS**

- A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Carbon-Steel-Headed Studs: ASTM A 108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Carbon-Steel Plate: ASTM A 283/A 283M, Grade C.
- D. Malleable-Iron Castings: ASTM A 47/A 47M, Grade 32510 or Grade 35028.
- E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30.
- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
- G. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or Grade C.
- H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A 496/A 496M or ASTM A 706/A 706M.
- J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- K. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.
  - 1. Do not zinc coat ASTM A 490 bolts.
- L. Welding Electrodes: Comply with AWS standards.
- M. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

## **2.08 STAINLESS STEEL CONNECTION MATERIALS**

- A. Stainless Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201.
- B. Stainless Steel Bolts and Studs: ASTM F 593, Alloy Group 1 or 2, hex-head bolts and studs; ASTM F 594, Alloy Group 1 or 2 stainless steel nuts; and flat, stainless steel washers.
  - 1. Lubricate threaded parts of stainless steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless Steel-Headed Studs: ASTM A 276, Alloy 304 or 316, with minimum mechanical properties of PCI MNL 116.

## **2.09 BEARING PADS**

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
  - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi, ASTM D 412.



2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

## **2.10 ACCESSORIES**

- A. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

## **2.11 GROUT MATERIALS**

- A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.
- B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

## **2.12 CONCRETE MIXTURES**

- A. Prepare design mixtures for each type of precast concrete required.
  1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
  2. Limit use of fly ash to 20 percent replacement of portland cement by weight and ground granulated blast-furnace slag to 20 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  1. Compressive Strength (28 Days): As required by Precast Designer.
  2. Maximum Water-Cementitious Materials Ratio: 0.45.

- E. Water Absorption: For structural precast concrete with an architectural finish, limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.
  - 1. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft., plus or minus 3 lb/cu. ft., according to ASTM C 567.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

### **2.13 MOLD FABRICATION**

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
  - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
  - 1. Form joints are not permitted on faces of structural precast concrete with an architectural finish that is exposed to view in the finished work.

### **2.14 FABRICATION**

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
  - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
  - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in

- ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
  3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
  4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
  2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
  3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
  4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
  5. Protect strand ends and anchorages with a minimum of 1-inch-thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
- K. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- L. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.
- M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

- N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

## **2.15 FABRICATION TOLERANCES**

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

## **2.16 COMMERCIAL FINISHES**

- A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in.. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

### **3.02 INSTALLATION**

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
  - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
  - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of Architect.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
  2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil-thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.
  3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
  4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
  2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
    - a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
    - b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
    - c. Twist-off Tension Control Bolt: ASTM F 1852.
    - d. Direct-Tension Control Bolt: ASTM F 1852.
  3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.
- H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
  2. Fill joints completely without seepage to other surfaces.
  3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
  4. Place grout end cap or dam in voids at ends of hollow-core slabs.
  5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
  6. Keep grouted joints damp for not less than 24 hours after initial set.

### **3.03 ERECTION TOLERANCES**

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

### **3.04 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Erection of precast structural concrete members.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

### **3.05 REPAIRS**

- A. Repair precast structural concrete units if permitted by Architect.
  - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

### **3.06 CLEANING**

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
  - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
  - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

**END OF SECTION**





## **SECTION 03 5400 - CAST UNDERLAYMENT**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Liquid-applied self-leveling floor underlayment.

#### **1.02 REFERENCE STANDARDS**

- A. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - 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, mixing instructions, environmental limitations, storage and handling requirements, and installation instructions.

#### **1.04 QUALITY ASSURANCE**

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

#### **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 (41 degrees C).

#### **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 (10 degrees C) 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. Gypsum Underlayment:
  1. ARDEX Engineered Cements: [www.ardexamericas.com](http://www.ardexamericas.com).
  2. Dependable Chemical Co., Inc: [www.floorprep.com](http://www.floorprep.com).
  3. Hacker Industries, Inc: [www.hackerindustries.com](http://www.hackerindustries.com).
  4. Maxxon Corporation: [www.maxxon.com](http://www.maxxon.com).
  5. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 MATERIALS

- A. Gypsum-Based Underlayment <CAST UNDLMNT-1>: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
  - 1. Basis of Design: Gyp-Crete by Maxxon Corporation.
  - 2. Application: All areas indicated to receive carpet or other soft flooring materials.
  - 3. Compressive Strength: Minimum 2200 psi (15 MPa), tested per ASTM C472.
  - 4. Density: Maximum 115 lb/cu ft (1842 kg/cu m).
  - 5. Final Set Time: 1 to 2 hours, maximum.
  - 6. Thickness: 3/4 inch (19 mm) to maximum 3-1/2 inch (89 mm).
  - 7. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
  
- B. Gypsum-Based Underlayment <CAST UNDLMNT-1>: Gypsum based mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
  - 1. Basis of Design: Dura-Cap by Maxxon Corporation.
  - 2. Application: All areas indicated to receive linoleum, tile, or other resilient flooring materials.
  - 3. Compressive Strength: Minimum 3500 psi (24.13 MPa), tested per ASTM C472.
  - 4. Density: Maximum 115 lb/cu ft (1842 kg/cu m).
  - 5. Final Set Time: 1 to 2 hours, maximum.
  - 6. Thickness: 1/2 inch (13 mm) to maximum 3-1/2 inch (89 mm).
  - 7. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
  
- C. Sound Deadening Mat <CAST UNDLMNT-12>: Gypsum based underlayment above with sound deadening mat.
  - 1. Basis of Design: Acousti-Mat II by Maxxon Corporation.
  - 2. Thickness: 1/4 inch.
  
- D. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/8 inch (3 mm) in size and acceptable to underlayment manufacturer.
  
- E. Water: Potable and not detrimental to underlayment mix materials.
  
- F. Primer: Manufacturer's recommended type.
  
- G. 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. Add aggregate for areas where thickness will exceed 1/2 inch (12.7 mm). Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
  
- C. 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: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- 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. Pump or pour material onto substrate. Do not retemper or add water.
  - 1. Pump, move, and screed while the material is still highly flowable.
  - 2. Be careful not to create cold joints.
  - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft (1:1000).

### **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**



## **SECTION 04 2000 - UNIT MASONRY**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Concrete Block.
- B. Clay Facing Brick.
- C. Mortar and Grout.
- D. Reinforcement and Anchorage.
- E. Flashings.
- F. Accessories.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

#### **1.03 REFERENCE STANDARDS**

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; 2011.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- E. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile; 2014.
- F. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2014.
- G. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
- H. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2011.
- I. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- J. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- K. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- L. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).

- M. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2014.
- N. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- O. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- P. ASTM C476 - Standard Specification for Grout for Masonry; 2010.
- Q. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.
- R. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength; 2013.
- S. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2008).
- T. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2014.
- U. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014.
- V. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2005.
- W. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
- X. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2005.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

#### **1.05 MOCK-UP**

- A. Construct a masonry wall as a mock-up panel sized 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), and wall insulation in mock-up.
- B. Locate where directed.
- C. Mock-up may not remain as part of the Work.

## 1.06 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 PRODUCTS

### 2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on the drawings for specific locations.
  - 2. Special Shapes: Provide non-standard blocks configured for corners.
  - 3. Load-Bearing Units: ASTM C90, normal weight.
    - a. Hollow block.
  - 4. Non-Loadbearing Units: ASTM C129.
    - a. Hollow block.
  - 5. Patterns and Faces:
    - a. <CMU-1>: Manufacturer's standard color and texture.
    - b. <CMU-2>: Rock faced; integral color Tumbleweed by Anchor Block.
    - c. Supplier of prefinished or integrally colored units shall guarantee that the finished product will not be stained or damaged due to iron or shale deposits in the face for a period of 5 years.
  - 6. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
    - a. Performance of Units with Integral Water Repellent:
      - 1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
        - (a) No water visible on back of wall above flashing at the end of 24 hours.
        - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.
        - (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
      - 2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
      - 3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
      - 4) Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
    - b. Use only in combination with mortar and grout that also has integral water repellent admixture.
    - c. Use water repellent admixtures for masonry units, mortar and grout by a single manufacturer.

### 2.02 BRICK UNITS

- A. Facing Brick <BRICK-1>: ASTM C216, Type FBS Smooth, Grade SW.
  - 1. Color and texture: BrickCraft, Harvest Blend, velour.
  - 2. Nominal size: Modular.
  - 3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

### 2.03 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type S.
- B. Portland Cement: ASTM C150/C150M, Type I.

- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.
- G. Integral Water Repellent Admixture for Mortar and Grout: Polymeric liquid admixture added to mortar and grout at the time of manufacture.
  - 1. Use only in combination with masonry units manufactured with integral water repellent admixture.
  - 2. Use only water repellent admixture for mortar and grout from the same manufacturer as water repellent admixture in masonry units.
  - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.

#### **2.04 REINFORCEMENT AND ANCHORAGE**

- A. Manufacturers:
  - 1. Blok-Lok Limited: [www.blok-lok.com](http://www.blok-lok.com).
  - 2. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
  - 3. WIRE-BOND: [www.wirebond.com](http://www.wirebond.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa), deformed billet bars; galvanized.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Single Wythe Joint Reinforcement: Ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not more than 1 inch (25 mm) and not less than 1/2 inch (13 mm) of mortar coverage on each exposure.
- E. Brick Ties <BRICK TIE>: Provide brick ties listed below at applicable locations. Where no appropriate brick tie is specified for a specific application, coordinate selection with Architect.
- F. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  - 1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
  - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
  - 3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

#### **2.05 FLASHINGS**

- A. Rubberized Asphalt Flashing <TWF-1>: Self-adhering polymer modified asphalt sheet, laminated to stainless steel drip; 40 mils (0.040 inch) (1.0 mm) minimum total thickness; with cross laminated polyethylene top and bottom surfaces. Provide stainless steel termination bar over flashing, fastened at 16 inches on center.
  - 1. Manufacturers:



- a. Advanced Building Products, Inc.; Strip-N-Flash: [www.advancedbuildingproducts.com/sle](http://www.advancedbuildingproducts.com/sle).
- b. York Manufacturing, Inc; York Seal: [www.yorkmfg.com](http://www.yorkmfg.com).
- c. Carlisle Coatings & Waterproofing; Product CCW-705-TWF: [www.carlislecw.com](http://www.carlislecw.com).
- d. W.R. Grace; Product Perm-A-Barrier Wall Flashing.
- e. Substitutions: See Section 01 6000 - Product Requirements.

## 2.06 ACCESSORIES

- A. Preformed Control Joints <MAS ACC-1>: Rubber material. Provide with corner and tee accessories, fused joints.
- B. Cavity Mortar Control <MAS ACC-5>: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
  - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
    - a. Manufacturers:
      - 1) Advanced Building Products Inc; Mortar Break: [www.advancedflashing.com/sle](http://www.advancedflashing.com/sle).
      - 2) Mortar Net Solutions: [www.mortarnet.com](http://www.mortarnet.com).
      - 3) Substitutions: See Section 01 6000 - Product Requirements.
- C. Termination Bars: Stainless steel; compatible with membrane and adhesives.
- D. Drip Edge: Stainless steel; compatible with membrane and adhesives.
- E. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.
- F. Weeps <MAS ACC-2>:
  - 1. Type: Polyester mesh.
  - 2. Manufacturers:
    - a. CavClear/Archovations, Inc: [www.cavclear.com](http://www.cavclear.com).
    - b. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
    - c. Mortar Net Solutions: [www.mortarnet.com](http://www.mortarnet.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- G. Cavity Vents:
  - 1. Type: Polyester mesh.
  - 2. Manufacturers:
    - a. CavClear/Archovations, Inc: [www.cavclear.com](http://www.cavclear.com).
    - b. Hohmann & Barnard, Inc: [www.h-b.com/sle](http://www.h-b.com/sle).
    - c. Mortar Net Solutions: [www.mortarnet.com](http://www.mortarnet.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- H. Multicomponent Cavity Wall Drainage System: Combination mortar diverter, flashing and weep system.
  - 1. Contractor's option to provide a multicomponent system in lieu of, or in addition to, individual components (<TWF-1>, <MAS ACC-2>, and <MAS ACC-5>) as specified herein.
  - 2. Membrane Type: Rubberized asphalt.
  - 3. Drip Edge: Stainless steel.
  - 4. Termination Bar: Stainless steel
  - 5. System Unit Length: 50 feet (15.24 m).
  - 6. Manufacturers:
    - a. Mortar Net Solutions: [www.mortarnet.com](http://www.mortarnet.com).

- b. Substitutions: See Section 01 6000 - Product Requirements.
- I. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.
  - 1. Acceptable Products: Contractor's option to achieve the specified results without damage to masonry or surrounding materials, such as Sure Klean by Prosoco or other product with similar properties.
  - 2. Use in strict accordance with manufacturer's written instructions.

## **2.07 MORTAR AND GROUT MIXES**

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 COLD AND HOT WEATHER REQUIREMENTS**

- A. Comply with requirements of ACI 530/530.1/ERTA or applicable building code, whichever is more stringent.

### **3.03 COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Mortar Joints: Concave.
- D. Brick Units:
  - 1. Bond: Running.
  - 2. Mortar Joints: Concave.

### **3.04 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners, except for units laid in stack bond.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Isolate masonry partitions from vertical structural framing members with a control joint.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### **3.05 WEEPS/CAVITY VENTS**

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

### **3.06 CAVITY MORTAR CONTROL**

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### **3.07 REINFORCEMENT AND ANCHORAGE - GENERAL**

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Lap joint reinforcement ends minimum 6 inches (150 mm).

### **3.08 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY**

- A. Install horizontal joint reinforcement 8 inches (200 mm) on center.

- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Lap joint reinforcement ends minimum 6 inches (150 mm).

### **3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER**

- A. Install horizontal joint reinforcement 16 inches (400 mm) on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches (150 mm).
- E. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches (400 mm) on center vertically and 24 inches (600 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

### **3.10 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
- B. Extend rubberized asphalt flashings to within 1/4 inch (6 mm) of exterior face of masonry.
- C. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

### **3.11 LINTELS**

- A. Install loose steel lintels over openings.
- B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
  - 1. Openings over 48 inches not scheduled: Contact Structural Engineer.

### **3.12 GROUTED COMPONENTS**

- A. Follow lap splice requirements as indicated in Structural drawings.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

### **3.13 CONTROL AND EXPANSION JOINTS**

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

- C. Size control joints as indicated on drawings; if not shown, 3/4 inch (19 mm) wide and deep.

### **3.14 TOLERANCES**

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

### **3.15 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Clay Masonry Unit Tests: Test each variety of clay masonry in accordance with ASTM C67 requirements, sampling 5 randomly chosen units for each 50,000 installed.
- C. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for conformance to requirements of this specification.
- D. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

### **3.16 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.

### **3.17 PROTECTION**

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

## **END OF SECTION**



## **SECTION 04 7200 - CAST STONE MASONRY**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Architectural cast stone.
- B. Units required are:
  - 1. Exterior wall units, including sills and other items as indicated.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 04 2000 - Unit Masonry: Installation of cast stone in conjunction with masonry.
- B. Section 07 9200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

#### **1.03 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2015.
- C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2009.
- D. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2014.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- G. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
- I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- J. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2010.
- K. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2016.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Test results of cast stone components made previously by the manufacturer.
- C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.

- D. Mortar Color Selection Samples.
- E. Verification Samples: Pieces of actual cast stone components not less than 6 inches (152 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. A firm with a minimum of 5 years experience producing cast stone of types required for project.
  - 2. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.
- B. Mock-Up: Provide full size cast stone components for installation in mock-up of exterior wall.
  - 1. Approved mock-up will become standard for appearance and workmanship.
  - 2. Mock-up may not remain as part of the completed work.
  - 3. Remove mock-up not incorporated into the work and dispose of debris.

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

- A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
- B. Number each piece individually to match shop drawings and schedule.
- C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
- E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
- F. Store mortar materials where contamination can be avoided.
- G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Architectural Cast Stone: All cast stone shall be provided by a single manufacturer.
  - 1. Reading Rock.
  - 2. Heritage Cast Stone, Inc.
  - 3. Arriscraft.
  - 4. Gage Brothers Concrete Products, Inc.
  - 5. American Artstone.
  - 6. Stoneworks Architectural Precast.
  - 7. Substitutions: See Section 01 6000 - Product Requirements.



## 2.02 ARCHITECTURAL CAST STONE

- A. Cast Stone <CAST STN-1>: Architectural concrete product manufactured to simulate appearance of natural limestone, complying with ASTM C1364.
  - 1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
  - 2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
  - 3. Finish: Acid etched, medium finish.
  - 4. Basis of Design: ReadingRock; Rockcast; Charlotte Tan.
  - 5. Remove cement film from exposed surfaces before packaging for shipment.
  - 6. For locations too large for a single cast stone unit, coordinate joint locations with Architect.
- B. Shapes: Provide shapes indicated on drawings.
  - 1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
  - 2. Unless otherwise indicated on drawings, provide:
    - a. Wash or slope of 1:12 on exterior horizontal surfaces.
    - b. Drips on projecting components, wherever possible.
    - c. Raised fillets at back of sills and at ends to be built in.
- C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.

## 2.03 MATERIALS

- A. Portland Cement: ASTM C150/C150M.
  - 1. For Units: Type I, white or gray as required to match Architect 's sample.
  - 2. For Mortar: Type I or II, except Type III may be used in cold weather.
- B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.
- D. Pigments: ASTM C979, inorganic iron oxides; do not use carbon black.
- E. Admixtures: ASTM C494/C494M.
- F. Water: Potable.
- G. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized.
  - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
- H. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
- I. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- J. Mortar: Portland cement-lime, as specified in Section 04 2000.
- K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry

surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.
- B. Do not begin installation until unacceptable conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 2000.
- B. Mechanically anchor cast stone units indicated; set remainder in mortar.
- C. Setting:
  - 1. Drench cast stone components with clear, running water immediately before installation.
  - 2. Set units in a full bed of mortar unless otherwise indicated.
  - 3. Fill vertical joints with mortar.
  - 4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
- D. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
  - 1. Rake mortar joints 3/4 inch (19 mm) for pointing.
  - 2. Remove excess mortar from face of stone before pointing joints.
  - 3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
  - 4. Leave the following joints open for sealant:
    - a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
    - b. Joints in projecting units.
    - c. Joints between rigidly anchored units, including soffits, panels, and column covers.
    - d. Joints below lugged sills and stair treads.
    - e. Joints below ledge and relieving angles.
    - f. Joints labeled "expansion joint".
- E. Installation Tolerances:
  - 1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
  - 2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
  - 3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
  - 4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.
- F. Repairs: Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).
  - 1. Repair with matching touchup material provided by the manufacturer and in accordance with manufacturer's instructions.
  - 2. Repair methods and results subject to Architect 's approval.

### **3.03 CLEANING**

- A. Keep cast stone components clean as work progresses.

### **3.04 PROTECTION**

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

**END OF SECTION**



## **SECTION 05 5000 - METAL FABRICATIONS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Shop fabricated steel items.
- B. Prefabricated ladders and ship ladders.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 04 2000 - Unit Masonry: Placement of metal fabrications in masonry.

#### **1.03 REFERENCE STANDARDS**

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- E. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength; 2014.
- F. ASTM A325M - Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric); 2014.
- G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- H. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.
- I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 1999 (Ed. 2004).
- N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

- O. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M, Grade B cold-formed structural tubing.
- C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- D. Bolts, Nuts, and Washers: ASTM A325 (ASTM A325M), Type 1, plain.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- H. <MET FAB-21>: Prefinished metal sheet. 26 gauge minimum. Color as selected by architect.

#### **2.02 MATERIALS - STAINLESS STEEL**

- A. Stainless Steel Sheet <MET FAB-22>: ASTM A666, Type 304; stretcher-leveled.

#### **2.03 FABRICATION**

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

#### **2.04 FABRICATED ITEMS**

- A. Ladder (Elevator Pit): Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.

1. Side Rails: 3/8 x 2 inches (9 x 50 mm) members spaced at 20 inches (500 mm).
  2. Rungs: one inch (25 mm) diameter solid round bar spaced 12 inches (300 mm) on center.
  3. Space rungs 7 inches (175 mm) from wall surface.
- B. Bollards <MTL FAB-1>: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish; six inch diameter unless noted otherwise in drawings.
1. <MTL FAB-2>: Provide an HDPE cover with covered top over the steel bollard. Color as selected by Architect.
- C. Door Frames for Overhead Door Openings: Channel sections; prime paint finish.
- D. Slotted Channel Framing <MET FAB-5>: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
1. Basis of Design: Unistrut System by Atkore International. Provide system components sized to accommodate the equipment and material loads anticipated based on the drawings and specifications.

## **2.05 PREFABRICATED LADDERS**

- A. Prefabricated Ship Ladder <SHIP LADDER-1>: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
  2. Materials: Aluminum; ASTM B221 (ASTM B221M), 6063 alloy, T52 temper.
  3. Incline: 60 degrees.
  4. Finish: Powder coat; color to be selected by Architect from manufacturer's standard range.
  5. Basis of Design Product:
    - a. O'Keeffe's Inc; Model 520: [www.okeeffes.com/sle](http://www.okeeffes.com/sle).

## **2.06 FINISHES - STEEL**

- A. Prime paint steel items.
1. Exceptions: Galvanize items to be embedded in concrete and items to be imbedded in masonry.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

## **2.07 FABRICATION TOLERANCES**

- A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).
- C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).
- D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).
- E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive work.

### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.

### **3.03 INSTALLATION**

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

### **3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).
- C. Maximum Out-of-Position: 1/4 inch (6 mm).

## **END OF SECTION**



## **SECTION 05 5913 - METAL BALCONIES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Metal balcony and supports.
- B. Balcony railings and guardrails.
- C. Aluminum sun screens.

#### **1.02 PERFORMANCE REQUIREMENTS**

- A. Design and fabricate to support a uniform live load of 100 lbs/sf and a concentrated load of 300 lbs/sf with a deflection not to exceed L/240 or 1/4 inch, whichever is less.
- B. Thermal Movement: Provide exterior metal fabrications that allow for movements resulting from the following maximum change in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
  - 1. Ambient Temperature Range: -20 degrees F to 100 degrees F.
  - 2. Material Surface Temperature Range: -20 degrees F to 150 degrees F.
- C. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot (1095 N/m) applied to the top of the assembly and in any direction, without damage or permanent set.
- D. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
  - 1. Include signed or stamped drawings by the registered structural engineer responsible for structural design of the system.

#### **1.04 QUALITY ASSURANCE**

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with no less than five years of documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section.
  - 1. With minimum five years of documented experience.
  - 2. Approved by manufacturer.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Metal Balconies, Rails, and Sun Screens:
  - 1. Endurable; [www.endurable.com](http://www.endurable.com).
  - 2. Classic Industries, Inc; AlumaDeck: [www.alumadeck.com](http://www.alumadeck.com).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 BALCONIES**

- A. Decking: 2 by 6 extruded aluminum planks.
- B. Shop Assembly: Preassemble items in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly label units for reassembly and coordinate installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges, unless otherwise indicated. Remove sharp or rough areas on exposed finishes.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- F. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base materials.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove weld flux immediately.
- G. Form exposed connections flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
- H. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

### **2.03 RAILINGS**

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- B. Dimensions: See drawings for configurations and heights.
- C. 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.

- D. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

#### **2.04 SUN SCREEN**

- A. Sun Screens <SUN SCR-1>: Shop fabricated, shop finished, extruded aluminum outriggers, louvers, and fascia, free of defects impairing strength, durability or appearance.
  - 1. Configuration: As indicated on drawings.
  - 2. Louver Type: Airfoil.
  - 3. Sun Screen Angle: 35 degrees from horizontal.
  - 4. Outrigger Shape: Bullnose.

#### **2.05 ALUMINUM MATERIALS**

- A. Aluminum Plate: Alloy 6063-T6.
- B. Aluminum Extrusions: Alloy 6063-T6.
- C. Aluminum Sheet: Alloy 5052-H32.
- D. Aluminum Woven Mesh: Alloy 1350-H19.
- E. Aluminum Pipe: Schedule 40; ASTM B429/B 429M, ASTM B241/B 241M, or ASTM B483/B 483M.
- F. Aluminum Tube: Minimum wall thickness of 0.127 inch (3.2 mm); ASTM B429/B 429M, ASTM B241/B 241M, or ASTM B483/B 483M.
- G. Solid Bars and Flats: ASTM B211 (ASTM B211M).
- H. Non-Weld Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- I. Welding Fittings: No exposed fasteners; cast aluminum.
- J. Exposed Fasteners: No exposed bolts or screws.

#### **2.06 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.

## **2.07 ALUMINUM FINISHES**

- A. Polyester Powder Coating Heat Cured.
  1. Provide powder coating with integral slip resistant grit for traffic surfaces such as balcony decking.
- B. Color: Black.

## **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.
- C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Cutting, Fitting and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevations; with edges and surfaces level, plumb, true, and free of rack; and measured from established liens and levels.
- C. Fit exposed connections accurately together to form tight joints. Do not weld, cut or abrade surfaces of exterior units that are for bolted or screwed field connections.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- G. Anchor railings securely to structure.
- H. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.

### **3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

**END OF SECTION**



## **SECTION 06 1000 - ROUGH CARPENTRY**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Structural dimension lumber framing.
- B. Sheathing.
- C. Roof-mounted curbs.
- D. Roofing nailers.
- E. Preservative treated wood materials.
- F. Fire retardant treated wood materials.
- G. Miscellaneous framing and sheathing.
- H. Concealed wood blocking, nailers, and supports.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2012.
- E. PS 1 - Structural Plywood; 2009.
- F. PS 20 - American Softwood Lumber Standard; 2010.
- G. SPIB (GR) - Grading Rules; 2014.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

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

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

## **PART 2 PRODUCTS**

### **2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. Species: Spruce-Pine-Fir (South), unless otherwise indicated.
  - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
  - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee ([www.alsc.org](http://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 FOR CONCEALED APPLICATIONS**

- 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. Stud Framing (2 by 2 through 2 by 6 (50 by 50 mm through 50 by 150 mm )):
  - 1. Species: Spruce-Pine-Fir.
  - 2. Grade: No. 2.
- E. Joist, Rafter, and Small Beam Framing (2 by 6 through 4 by 16 (50 by 150 mm through 100 by 400 mm )):
  - 1. Machine stress-rated (MSR) as follows:
    - a. Fb-single (minimum extreme fiber stress in bending): 1350 psi (9,300 kPa).
    - b. E (minimum modulus of elasticity): 1,300,000 psi (8960 MPa).
  - 2. Species: Spruce-Pine-Fir (South).
- F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring <WD BLKG>:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

### **2.03 STRUCTURAL COMPOSITE LUMBER**

- A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
  - 1. Manufacturers:
    - a. Weyerhaeuser: [www.weyerhaeuser.com](http://www.weyerhaeuser.com).
    - b. Boise Cascade: [www.bc.com](http://www.bc.com).
    - c. Georgia-Pacific Corp.: [www.buildgp.com](http://www.buildgp.com).



- d. Substitutions: See Section 01 6000 - Product Requirements.

## 2.04 CONSTRUCTION PANELS

- A. General Wood Panel Products:
  - 1. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
  - 2. Factory mark panels to indicate compliance with applicable standards.
- B. Floor Sheathing <WD SHTG-1>: APA PRP-108, Rated Sturd-I-Floor, unless otherwise noted on drawings.
  - 1. Bond Classification: Exposure 1.
  - 2. Span Rating: 16.
  - 3. Edges: Tongue and groove.
  - 4. Thickness: 3/4 inch.
- C. Roof Sheathing <WD SHTG-14>: Oriented strand board wood structural panel; PS 2.
  - 1. Grade: Structural 1 Sheathing.
  - 2. Performance Category: 1/2 PERF CAT. with H-Clips.
- D. Wall Sheathing <WD SHTG-#>: Oriented strand board, PS 2, Structural I Rated Sheathing, Exterior Exposure Class, unless otherwise noted on drawings, and as follows:
  - 1. <WD SHTG-20>: 15/32 inch thick.
  - 2. <WD SHTG-24>: 3/4 inch thick.
- E. Fiberglass Reinforced Plastic (FRP) Panels <FRP PNL-10>:
  - 1. Product: P100 - Pebble Surface by Marlite FRP or approved equal.
  - 2. Color: As selected from manufacturer's full range.
  - 3. FRP Trim and Fasteners: Same color, finish, and manufacturer as FRP panel, provide all matching trim needed for installation of FRP panels.
  - 4. Application: Provide within 4 feet of mop sinks and other locations as indicated.
- F. Other Applications:
  - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
  - 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
  - 3. Other Locations: PS 1, C-D Plugged or better.

## 2.05 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.
  - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
- B. Subfloor Glue: Waterproof, air cure type, cartridge dispensed.
- C. Water-Resistive Barrier: As specified in Section 07 2500.

## 2.06 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
  2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
1. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
    - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    - b. Do not use treated wood in direct contact with the ground.
  2. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
    - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    - b. Treat rough carpentry items as indicated .
    - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
1. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
    - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
  2. Preservative Pressure Treatment of Plywood Above Grade: AWWA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
    - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
  3. Preservative Pressure Treatment of Lumber in Contact with Soil: AWWA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
    - a. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

## **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 and AFPA (WFCM) Wood Frame Construction Manual.
- 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.

### **3.05 INSTALLATION OF CONSTRUCTION PANELS**

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.
  - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.
- C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
  - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
  - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
  - 3. Install adjacent boards without gaps.
  - 4. Size and Location: As indicated on drawings.

### **3.06 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

### **3.07 TOLERANCES**

- A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

- B. Surface Flatness of Floor: 1/8 inch in 10 feet (1 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.
- C. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

### **3.08 CLEANING**

- A. Waste Disposal: Comply with the requirements of Section 01 7419 - 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 any 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**

# SECTION 06 1753 - SHOP-FABRICATED WOOD TRUSSES

## 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. Wood roof trusses.
  2. Wood floor trusses.
  3. Wood girder trusses.

### 1.03 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

### 1.04 ACTION SUBMITTALS

- A. Product Data: For wood-preserved-treated lumber, fire-retardant-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.
  1. Include data for wood-preserved treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification from treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
  4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.
- B. Shop Drawings: Show fabrication and installation details for trusses.
  1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
  2. Indicate sizes, stress grades, and species of lumber.
  3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
  4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
  5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
  6. Show splice details and bearing details.
- C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### **1.05 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For metal connector-plate manufacturer professional engineer and fabricator.
- B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.
- D. Evaluation Reports: For the following, from ICC-ES:
  - 1. Wood-preserved-treated lumber.
  - 2. Fire-retardant-treated wood.
  - 3. Metal-plate connectors.
  - 4. Metal truss accessories.

### **1.06 QUALITY ASSURANCE**

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
  - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
  - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

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

- A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
  - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
  - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
  - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

## **PART 2 - PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design metal-plate-connected wood trusses.

- B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
  - 1. Design Loads: As indicated.
  - 2. Maximum Deflection under Design Loads:
    - a. Roof Trusses: Vertical deflection of As Indicated of span.
    - b. Floor Trusses: Vertical deflection of As Indicated of span.
- C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

## **2.02 DIMENSION LUMBER**

- A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
  - 3. Provide dressed lumber, S4S.
  - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Minimum Specific Gravity for Top Chords: 0.42.
- C. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 06 1000 "Rough Carpentry."

## **2.03 METAL CONNECTOR PLATES**

- A. General: Fabricate connector plates to comply with TPI 1.
- B. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.
  - 1. Use for interior locations unless otherwise indicated.

## **2.04 FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
  - 2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

## **2.05 METAL FRAMING ANCHORS AND ACCESSORIES**

- A. Allowable design loads, as published by manufacturer, shall comply with or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
  - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
  - 1. Use for wood-preservative-treated lumber and where indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304 Type 316.

## **2.06 MISCELLANEOUS MATERIALS**

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

## **2.07 FABRICATION**

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
  - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

## **2.08 SOURCE QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.
  - 1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
  - 2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.



## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
  - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
  - 1. Install bracing to comply with Section 06 1000 "Rough Carpentry."
  - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not comply with requirements.
  - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

### **3.02 REPAIRS AND PROTECTION**

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A 780/A 780M and manufacturer's written instructions.

### **3.03 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

**END OF SECTION**

## **SECTION 06 2000 - FINISH CARPENTRY**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Finish carpentry items.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 09 9123 - Interior Painting: Painting and finishing of finish carpentry items.

#### **1.03 REFERENCE STANDARDS**

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Samples: Submit two samples of wood trim 6 inch (152 mm) long.

#### **1.05 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

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

- A. Protect work from moisture damage.

### **PART 2 PRODUCTS**

#### **2.01 FINISH CARPENTRY ITEMS**

- A. Quality Standard: Custom Grade, in accordance with 1, unless noted otherwise.

#### **2.02 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.

#### **2.03 LUMBER MATERIALS**

- A. <WD BASE-1> and <WD TRIM-1>: Legacy embossed by Lianga Pacific, Inc; color Honey.
- B. <WD BASE-2> and <WD TRIM-2>: Prefinished poplar with Cherry finish.

#### **2.04 SHEET MATERIALS**

- A. <WD PNLG-2>: Prefinished poplar panel with cherry finish.

## **2.05 ACCESSORIES**

- A. Primer: Alkyd primer sealer.
- B. Wood Filler: Solvent base, tinted to match surface finish color.
- C. Wood Coat Rack: Oak coat and hat rack with hanging rod.
  - 1. Basis of Design: Wooden Mallet Double Coat & Hat Rack, 64" with Dark Red Mahogany finish by Private School Partner: [www.privateschoolpartner.com](http://www.privateschoolpartner.com).

## **2.06 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.

### **3.02 INSTALLATION**

- A. Install work in accordance with [] requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.
- D. Install components with finish nails.

### **3.03 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 9123.
- C. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

### **3.04 TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch (1.6 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

## **END OF SECTION**

# **SECTION 07 1300 - SHEET WATERPROOFING**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Sheet membrane waterproofing.

### **1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 07 2100 - Thermal Insulation: Insulation used for protective cover.

### **1.03 REFERENCE STANDARDS**

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2015a).
- B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
- C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.
- D. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2010).
- E. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2015).
- F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.
- G. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2014.
- H. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2014).
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- J. 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 2013).

### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

## 1.05 QUALITY ASSURANCE

- A. Membrane Manufacturer Qualifications: Company specializing in waterproofing sheet membranes with three years experience.

## PART 2 PRODUCTS

### 2.01 MEMBRANE MATERIALS

- A. Self-Adhered Modified Bituminous Membrane <WTR PRF-2>: Self-adhesive, cold-applied composite sheet consisting of rubberized asphalt and cross-laminated, high density polyethylene film.
  1. Thickness: 60 mil (0.060 inch) (1.5 mm).
  2. Tensile Strength:
    - a. Film: 5000 pounds per square inch (34.57 MPa), minimum, measured according to ASTM D882 and at grip-separation rate of 2 inches (50 mm) per minute.
    - b. Membrane: 325 pounds per square inch (2.24 MPa), minimum, measured according to ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches (50 mm) per minute.
  3. Elongation at Break: 300 percent, minimum, measured according to ASTM D412.
  4. Water Vapor Permeance: 0.05 perm (2.9 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
  5. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F (minus 11 C), 180 degree bend on 1 inch (25 mm) mandrel.
  6. Low Temperature Installation: Installation air and surface temperature between 25 and 60 degrees F or lower.
  7. Peel Strength: 9 pounds per inch (1576 N/m), minimum, when tested according to ASTM D903.
  8. Lap Adhesion Strength: 5 pounds per inch (875.6 N/m), minimum, when tested according to ASTM D1876.
  9. Puncture Resistance: 50 pounds (22.67 kg), minimum, measured in accordance with ASTM E154/E154M.
  10. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
  11. Hydrostatic Resistance: Resists the weight of 200 feet (61 m) when tested according to ASTM D5385/D5385M.
  12. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
  13. Basis of Design Products:
    - a. Carlisle Coatings & Waterproofing Incorporated; MiraDRI 860/861: [www.carlisleccw.com/sle](http://www.carlisleccw.com/sle).
    - b. GCP Applied Technologies; Bituthene 3000/Low Temperature Membrane: [www.gcpat.com/sle](http://www.gcpat.com/sle).
    - c. W.R. Meadows, Inc; MEL-ROL Low Temp: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Self-Adhered HDPE Sheet Membrane with Weather-Resistant Coating <WTR PRF-7>: Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.
  1. Sheet Thickness: 46 mil (0.046 inch) (1.2 mm), minimum.
  2. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F (minus 11 C), 180 degree bend on 1 inch (25 mm) mandrel.
  3. Low Temperature Installation: Installation air and surface temperature between 25 and 60 degrees F or lower.

4. Hydrostatic Resistance: Resists the weight of 231 feet (70 m) when tested according to ASTM D5385/D5385M.
5. Elongation at Break: 500 percent, minimum, measured according to ASTM D412.
6. Tensile Strength, Film: 3,500 pounds per square inch (24 MPa), minimum, measured according to ASTM D412.
7. Lap Peel Adhesion: 8 pounds per inch (1408 N/m), minimum, when tested according to ASTM D1876.
8. Water Vapor Permeance: 0.01 perm (0.6 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
9. Bond to Concrete: 5 pounds per inch (875 N/m), minimum, per ASTM D903.
10. Lateral Water Migration Resistance: Resists the weight of 231 feet (70 m) when tested according to ASTM D5385/D5385M.
11. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
12. Manufacturers:
  - a. GCP Applied Technologies; Preprufe 300R Plus: [www.gcpat.com/sle](http://www.gcpat.com/sle).
  - b. Carlisle Coatings & Waterproofing Incorporated; MiraPLY-H: [www.carlisle-ccw.com](http://www.carlisle-ccw.com).
  - c. W.R. Meadows, Inc; PRECON Low Temp: [www.wrmeadows.com](http://www.wrmeadows.com).
  - d. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 ACCESSORIES

- A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
- B. Protection Board: Rigid insulation specified in Section 07 2100.
- C. Drainage Panel <DRAIN BRD-1>: Drainage layer with geotextile filter fabric on earth side.
  1. Also provide at locations where <INSUL-1> is not installed over <WTR PRF-2>.
  2. Composition: Dimpled polystyrene core; polypropylene filter fabric.
    - a. Products:
      - 1) Grace Construction Products; Hydroduct 200: [www.na.graceconstruction.com](http://www.na.graceconstruction.com).
      - 2) Carlisle Coatings & Waterproofing Incorporated; MiraDRAIN 2000: [www.carlisle-ccw.com](http://www.carlisle-ccw.com).
      - 3) W.R. Meadows, Inc; Mel-Drain: [www.wrmeadows.com](http://www.wrmeadows.com).
      - 4) Substitutions: See Section 01 6000 - Product Requirements.
- D. Flexible Flashings: Type recommended by membrane manufacturer.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify that items that penetrate surfaces to receive waterproofing are securely installed.

### 3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.

- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions. Vacuum substrate clean.
- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant, not rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.
- G. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
  1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
  2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in the reference standard.
  3. Remove and replace areas of defective concrete as specified in Section 03 3000.
  4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in the referenced standard.
  5. Test concrete surfaces as described in the referenced standards. Verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

### **3.03 INSTALLATION - MEMBRANE**

- A. Install membrane waterproofing in accordance with manufacturer's instructions.
- B. Roll out membrane. Minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer. Roll out on substrate with a mechanical roller to encourage full contact bond.
- D. Overlap edges and ends and seal by method recommended by manufacturer, minimum 3 inches (75 mm). Seal permanently waterproof.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.
- G. Install flexible flashings. Seal items penetrating through membrane with flexible flashings. Seal watertight to membrane.
- H. Seal membrane and flashings to adjoining surfaces. Install termination bar at all edges. Install counterflashing over all exposed edges.

### **3.04 INSTALLATION - DRAINAGE PANEL**

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.



B. Adhere drainage panel to substrate with compatible adhesive.

**3.05 PROTECTION**

A. Do not permit traffic over unprotected or uncovered membrane.

**END OF SECTION**



# **SECTION 07 2100 - THERMAL INSULATION**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Board insulation at perimeter foundation wall and exterior wall behind exterior wall finish.
- B. Batt insulation in exterior wall and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

### **1.02 RELATED REQUIREMENTS**

- A. Section 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
- B. Section 07 2126 - Blown Insulation: Blown-in, gravity-held fibrous insulation.
- C. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 07 5300 - Elastomeric Membrane Roofing: Insulation specified as part of roofing system.
- E. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

### **1.03 REFERENCE STANDARDS**

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2015a.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016.

### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

### **1.05 FIELD CONDITIONS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

## PART 2 PRODUCTS

### 2.01 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation <INSUL-1, 2>: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
1. Type: ASTM C578, Type IV.
  2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  4. R-value (RSI-value); 1 inch (25 mm) of material at 72 degrees F (22 C): 5 (0.88), minimum.
  5. Drainage Channels: Provide for <INSUL-1> locations.
  6. Board Edges: Square.
  7. Manufacturers:
    - a. Dow Chemical Company: [www.dow.com](http://www.dow.com).
    - b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: [www.ocbuildingspec.com/sle](http://www.ocbuildingspec.com/sle).
    - c. Kingspan Insulation LLC; GreenGuard XPS TYPE IV 25 PSI: [www.trustgreenguard.com](http://www.trustgreenguard.com).
    - d. Diversifoam Products: [www.diversifoam.com](http://www.diversifoam.com).
  8. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation <INSUL-20>: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
  3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
  4. Formaldehyde Content: Zero.
  5. Facing: Unfaced.
  6. Manufacturers:
    - a. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
    - b. Johns Manville: [www.jm.com](http://www.jm.com).
    - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: [www.ocbuildingspec.com/sle](http://www.ocbuildingspec.com/sle).
    - d. Knauf Insulation: [www.knaufinsulation.us](http://www.knaufinsulation.us).
  7. Substitutions: See Section 01 6000 - Product Requirements.
- C. Mineral Fiber Batt Insulation <INSUL-20>: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Where indicated, provide foil facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
  3. Manufacturers:
    - a. Johns Manville; MinWool Sound Attenuation Fire Batts: [www.jm.com/sle](http://www.jm.com/sle).
    - b. Thermafiber, Inc; SAFB: [www.thermafiber.com](http://www.thermafiber.com).
    - c. ROXUL, Inc; ComfortBatt: [www.roxul.com/sle](http://www.roxul.com/sle).

- d. Substitutions: See Section 01 6000 - Product Requirements.

### **2.03 ACCESSORIES**

- A. Sheet Vapor Retarder: Specified in Section 07 2500.
- B. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch (50 mm) wide.
- C. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- D. Adhesive: Type recommended by insulation manufacturer for application.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

### **3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER**

- A. Apply adhesive to back of boards in accordance with manufacturer's written instructions.
- B. Install boards horizontally on foundation perimeter.
  - 1. Place boards to maximize adhesive contact.
  - 2. Install in running bond pattern.
  - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### **3.03 BOARD INSTALLATION AT EXTERIOR WALLS**

- A. Install boards horizontally on walls.
  - 1. Place boards to maximize adhesive contact.
  - 2. Install in running bond pattern.
  - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Extend boards over expansion joints, unbonded to wall on one side of joint.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- D. Tape insulation board joints.

### **3.04 BATT INSTALLATION**

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Coordinate work of this section with requirements for vapor retarder specified in Section 07 2500.
- F. Coordinate work of this section with construction of air barrier seal specified in Section 07 2500.

**3.05 PROTECTION**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**

# **SECTION 07 2119 - FOAMED-IN-PLACE INSULATION**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Foamed-in-place insulation.

### **1.02 REFERENCE STANDARDS**

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2015.
- B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- E. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- F. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience.

### **1.05 FIELD CONDITIONS**

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Foamed-In-Place Insulation <INSUL-36>: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
  - 1. Aged Thermal Resistance: R-value (RSI-value) of 6.7 (deg F hr sq ft)/Btu (1.2 (K sqm)/W), minimum, when tested at 1 inch (25.4 mm) thickness in accordance with ASTM C518 after aging for 180 days at 41 degrees F (23 degrees C).
  - 2. Water Vapor Permeance: Vapor retarder; 2 perm (115 ng/(Pa s sqm)), maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
  - 3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
  - 4. Air Permeance: 0.004 cfm/sq ft (0.2 L/second sq meter), maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.5 psf (75 Pa).
  - 5. Closed Cell Content: At least 90 percent.
  - 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
  - 7. Products:
    - a. BASF Corporation; WALLTITE US: [www.spf.basf.com](http://www.spf.basf.com).
    - b. Henry Company; PERMAX 2.0: [www.henry.com/sle](http://www.henry.com/sle).
    - c. Icynene Inc; Icynene ProSeal MD-C-200v3: [www.icynene.com](http://www.icynene.com).
    - d. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: [www.jm.com/sle](http://www.jm.com/sle).
    - e. Rhino Linings Corporation; DuraTite CC2.5: [www.rhino linings.com/sle](http://www.rhino linings.com/sle).
    - f. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 ACCESSORIES**

- A. Primer: As required by insulation manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify work within construction spaces or crevices is complete prior to insulation application.

### **3.02 PREPARATION**

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

### **3.03 APPLICATION**

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.



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

- A. Field inspections and tests will be performed by an independent testing agency under provisions of Section 01 4000 - Quality Requirements.
- B. Inspection will include verification of insulation thickness and density.

#### **3.05 PROTECTION**

- A. Do not permit subsequent construction work to disturb applied insulation.

**END OF SECTION**



## **SECTION 07 2126 - BLOWN INSULATION**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Ceiling: Loose insulation pneumatically placed .

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 2100 - Thermal Insulation.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM C764 - Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation; 2011.
- B. ASTM C1015 - Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation; 2006 (Reapproved 2011).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, limitations .
- C. Manufacturer's Installation Instructions: Indicate procedure for preparation and installation.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Blown Insulation:
  - 1. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 2. GreenFiber: [www.greenfiber.com](http://www.greenfiber.com).
  - 3. Johns Manville: [www.jm.com](http://www.jm.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 MATERIALS**

- A. Loose Fill Insulation <INSUL-34>: ASTM C764, glass fiber type, bulk for pneumatic placement.
  - 1. Thermal Conductivity: 0.27 BTU in/(hr sq ft deg F) (0.0389 W/(m K)).
  - 2. Installed Thickness: As indicated on drawings.
- B. Ventilation Baffles: Formed plastic or cardboard.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.
- B. Verify that light fixtures have thermal cut-out device to restrict over-heating in soffit or ceiling spaces.

- C. Verify spaces are unobstructed to allow placement of insulation.

### **3.02 INSTALLATION**

- A. Install insulation and ventilation baffle in accordance with ASTM C1015 and manufacturer's instructions.
- B. Place insulation pneumatically to completely fill joist and rafter spaces.
- C. Place insulation against baffles. Do not impede natural attic ventilation to soffit.
- D. Completely fill intended spaces. Leave no gaps or voids.

### **3.03 CLEANING**

- A. Remove loose insulation residue.

### **END OF SECTION**

## **SECTION 07 2500 - WEATHER BARRIERS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor resistant and air tight.
- B. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.
- B. Section 07 5300 - Elastomeric Membrane Roofing: Vapor retarder installed as part of roofing system.
- C. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- D. Section 07 9200 - Joint Sealants: Sealing building expansion joints.

#### **1.03 DEFINITIONS**

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.  
Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
  - 1. Water Vapor Permeance: For purposes of conversion,  $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm}$ .

#### **1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; 2014.
- C. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.
- D. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- G. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

## 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

## 1.06 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

## PART 2 PRODUCTS

### 2.01 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier Sheet, Mechanically Fastened:
  - 1. <AIR BAR-1>: Mechanically fastened air barrier.
  - 2. Air Permeance: 0.004 cubic feet per minute per square foot (0.02 L/s/sq m), maximum, when tested in accordance with ASTM E2178.
  - 3. Water Vapor Permeance: 10 perms (574 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
  - 4. Water Penetration Resistance: Withstand a water head of 21 inches (55 cm), minimum, for minimum of 5 hours, when tested in accordance with AATCC Test Method 127.
  - 5. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 180 days weather exposure.
  - 6. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84.
  - 7. Seam and Perimeter Tape: Polyethylene self adhering type, mesh reinforced, 2 inches (50 mm) wide, compatible with sheet material; unless otherwise specified.
  - 8. Products:
    - a. DuPont Building Innovations; Tyvek Drainwrap (Basis of Design) approved accessory products: [www.dupont.com](http://www.dupont.com).
    - b. Materials:
      - 1) Jamb Flashings; Product "Straightflash"
      - 2) Sill Flashings; Product "Flexwrap"
      - 3) Sealing Tape; Tyvek Tape.
      - 4) Sealant: Sealant as recommended by manufacturer.
      - 5) Fasteners: Tyvek wrap caps or approved fasteners.
      - 6) "Quickflash" flashing panels for all pipe, conduit tube or wire penetrations through weather resisiant membrane,by QuickflashWeatherproofing Products, [www.quickflashproducts.com](http://www.quickflashproducts.com)
    - c. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

- A. Vapor Retarder Sheet <VPR RET-1>: ASTM D4397 polyethylene film , clear.
  - 1. Thickness: 6 mil (0.15 mm).

2. Water Vapor Permeance: As required by referenced standard for thickness specified.
- B. <VPR RET-10>: Contractor's option to provide a self-adhesive or liquid applied membrane as described in the following paragraphs.
- C. Vapor Retarder Sheet <VPR RET-10>: ASTM D1970/D1970M.
1. Thickness: 40 mil (0.040 inch) (1.02 mm), nominal.
  2. Water Vapor Permeance: 0.05 perm (2.87 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M.
  3. Seam and Perimeter Tape: As recommended by sheet manufacturer.
  4. Products:
    - a. Carlisle Coatings and Waterproofing, Inc.; Fire Resist 705FR-A: [www.carlisleccw.com/sle](http://www.carlisleccw.com/sle).
    - b. Henry Company; Blueskin SA: [www.henry.com/sle](http://www.henry.com/sle).
    - c. W.R. Meadows, Inc.; Air-Shield: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
    - d. Grace Construction Products; Perm-A-Barrier Wall Membrane: [www.graceconstruction.com](http://www.graceconstruction.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- D. Vapor Retarder Coating <VPR RET-10>: Liquid applied, resilient, UV-resistant coating and associated joint treatment.
1. Water Vapor Permeance: 0.2 perm (11.4 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96/E96M.
  2. VOC Content: Less than 100 g per L when tested in accordance with 40 CFR 59 Subpart D (EPA Method 24).
  3. Suitable for use on concrete, masonry, plywood and gypsum sheathing.
  4. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
  5. Products:
    - a. Carlisle Coatings and Waterproofing, Inc.; Product: Fire Resist Barritech NP; [www.carlisleccw.com/sle](http://www.carlisleccw.com/sle).
    - b. Henry Company; Air-Bloc 32MR: [www.henry.com/sle](http://www.henry.com/sle).
    - c. W.R. Meadows, Inc.; Air-Shield LSR: [www.wrmeadows.com/sle](http://www.wrmeadows.com/sle).
    - d. Grace Construction Products; Perm-A-Barrier Liquid: [www.graceconstruction.com](http://www.graceconstruction.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  6. Joint Filler: As recommended by coating manufacturer and suitable to the substrate.

### 2.03 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
1. Composition: Any material that meets physical requirements of ASTM D1970/D1970M with exceptions indicated.
  2. Thickness: 30 mil (0.030 inch) (0.76 mm), nominal; exception from 1.
  3. All flashing materials shall be compatible with, and approved by, the membrane manufacturer.
- C. Thinners and Cleaners: As recommended by material manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces and conditions are ready to accept the work of this section.

### **3.02 PREPARATION**

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's instructions.

### **3.03 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- D. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- E. Mechanically Fastened Sheets - On Exterior:
  - 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
  - 2. Overlap seams as recommended by manufacturer but at least 6 inches.
  - 3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches (305 mm).
  - 4. For applications specified to be air tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
  - 5. Where stud framing rests on concrete or masonry, extend lower edge of sheet at least 4 inches (100 mm) below bottom of framing and seal to foundation with sealant.
  - 6. Install air barrier and vapor retarder UNDER jamb flashings.
  - 7. Install head flashings under weather barrier.
  - 8. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
- F. Mechanically Fastened Sheets - Vapor Retarder On Interior:
  - 1. When insulation is to be installed in assembly, install vapor retarder over insulation.
  - 2. Anchor to wood framing using large-headed nails or staples at 12 to 18 inches (305 to 460 mm) on center along each framing member covered; cover fasteners with seam tape.
  - 3. Anchor to metal framing using seam tape, adhering at least one-half of tape width to substrate.
  - 4. Seal seams, laps, perimeter edges, penetrations, tears, and cuts with self-adhesive tape, making air tight seal.
  - 5. Locate laps at a framing member; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet.
  - 6. Seal entire perimeter to structure, window and door frames, and other penetrations.



7. Where conduit, pipes, wires, ducts, outlet boxes, and other items are installed in insulation cavity, pass vapor retarder sheet behind item but over insulation and maintain air tight seal.
- G. Self-Adhesive Sheets:
1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
  2. Lap sheets shingle-fashion to shed water and seal laps air tight.
  3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that all laps are firmly adhered with no gaps or fishmouths.
  4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
  5. At wide joints, provide extra flexible membrane allowing joint movement.
- H. Coatings:
1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
  2. Where exterior masonry veneer is to be installed, install masonry anchors before installing weather barrier over masonry; seal around anchors air tight.
  3. Use flashing to seal to adjacent construction and to bridge joints.
- I. Openings and Penetrations in Exterior Weather Barriers:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
  2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches (100 mm) wide; do not seal sill flange.
  3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
  4. At head of openings, install flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
  5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
  6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

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

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- C. Take digital photographs of each portion of the installation prior to covering up.

#### **3.05 PROTECTION**

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.
- B. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

### **END OF SECTION**



## **SECTION 07 3113 - ASPHALT SHINGLES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Asphalt shingle roofing.
- B. Flexible sheet membranes for eave protection, underlayment, and valley protection.
- C. Associated metal flashings and accessories.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Roof sheathing.
- B. Section 07 2100 - Thermal Insulation: Nailable rigid insulation.
- C. Section 07 6200 - Sheet Metal Flashing and Trim: Edge and cap flashings.
- D. Divisions 22 and 23: Mechanical work projecting through roof.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2015a.
- B. ASTM D3161/D3161M - Standard Test Method for Wind-Resistance of Steep Slope Roofing Products (Fan-Induced Method); 2016.
- C. ASTM D3462/D3462M - Standard Specification for Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules; 2010a.
- D. ASTM D4869/D4869M - Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing; 2016a.
- E. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2011.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- G. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating material characteristics and performance criteria.
- C. Shop Drawings: For metal flashings, indicate specially configured metal flashings.
- D. Samples: Submit two samples of each shingle color indicating color range and finish texture/pattern .
- E. Manufacturer's Installation Instructions: Indicate installation criteria and procedures.

- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Shingles: 150 sq ft (11.6 sq m) of each type and color.

### **1.05 QUALITY ASSURANCE**

- A. Products are Required to Comply with Fire Resistance Criteria: UL (DIR) listed and labeled.

### **1.06 FIELD CONDITIONS**

- A. Do not install shingles or eave protection membrane when surface temperatures are below 45 degrees F (7 degrees C).

### **1.07 WARRANTY**

- A. Provide Manufacturer's standard 30 year warranty.

## **PART 2 PRODUCTS**

### **2.01 SHINGLES**

- A. Manufacturers:
  - 1. Basis of Design: GAF; Timberline ArmorShield II: [www.gaf.com/sle](http://www.gaf.com/sle).
  - 2. Certainteed: [www.certainteed.com](http://www.certainteed.com).
  - 3. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 ASPHALT SHINGLES**

- A. Asphalt Shingles <SHINGLE-1>: Asphalt-coated fiber glass, mineral granule surfaced, complying with ASTM D3462/D3462M; Class A fire resistance.
  - 1. Fire Resistance: Class A.
  - 2. Wind Resistance: Class F, when tested in accordance with ASTM D3161/D3161M.
  - 3. Warranted Wind Speed: 110 mph (177 km/h).
  - 4. Algae Resistant.
  - 5. Weight: 235-245 lb/100 sq ft (107-111 kg/sq m).
  - 6. Self-sealing type.
  - 7. Basis of Design:
    - a. Color: Weathered Wood.
    - b. Lifetime limited warranty.

### **2.03 SHEET MATERIALS**

- A. Eave Protection Membrane <RF UNDLMT-5>: Self-adhering polymer-modified asphalt sheet complying with ASTM D1970; 40 mil (1 mm) total thickness; with strippable treated release paper and polyethylene sheet top surface.
- B. Underlayment <RF UNDLMT-3>: Synthetic non-asphaltic sheet, intended by manufacturer for mechanically fastened roofing underlayment without sealed seams.
  - 1. Self Sealability: Passing nail sealability test specified in ASTM D1970/D1970M.
  - 2. Flammability: Minimum of Class A, when tested in accordance with ASTM E108.

3. Ultraviolet Resistance and Weatherability: Approved in writing by manufacturer for exposure to weather for minimum of 6 months.
4. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.
5. Liquid Water Transmission: Passes ASTM D4869/D4869M.
6. Functional Temperature Range: Minus 70 degrees F (56.7 C) to 212 degrees F (100 C).
7. Fasteners: As specified by manufacturer and building code qualification report or approval, if any.
8. Manufacturers:
  - a. GAF; DeckArmor: [www.gaf.com](http://www.gaf.com).
  - b. CertainTeed; Roofers' Select: [www.certainteed.com](http://www.certainteed.com).
  - c. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.04 ACCESSORIES**

- A. Nails: Standard round wire shingle type, of hot-dipped zinc coated steel, 10 wire gage, 0.1019 inch (2.59 mm) shank diameter, 3/8 inch (9.5 mm) head diameter, of sufficient length to penetrate through roof sheathing or 3/4 inch (19 mm) into roof sheathing or decking.
- B. Lap Cement: Fibrated cutback asphalt type, recommended for use in application of underlayment, free of toxic solvents .
- C. Ridge Vents <RF VENT-1>: Plastic, extruded with vent openings that do not permit direct water or weather entry; flanged to receive shingles; ShingleVent II Class A manufactured by Air Vent Inc. or approved equal.
  1. Integral insect screen.
  2. Net Free Area: 16 square inches of ventilation per linear foot.

#### **2.05 METAL FLASHINGS**

- A. Metal Flashings: Provide sheet metal eave edge, gable edge, open valley flashing, and other flashing indicated on drawings.
  1. Form flashings to protect roofing materials from physical damage and shed water.
  2. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
  3. Hem exposed edges of flashings minimum 1/4 inch (6 mm) on underside.
- B. At 'visual' areas, Sheet Metal: Prefinished galvanized steel, 0.018 inch/26 gage (0.45 mm) thick, minimum G90/Z275 hot-dipped galvanized; fluoropolymer coated, color as selected.
- C. At 'non-visual', such as valley flashings, Sheet Metal: Galvanized steel, 0.018 inch/26 gage thick, minimum G90/Z275 hot-dipped galvanized.
- D. Bituminous Paint: Acid and alkali resistant type; black color.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions prior to beginning work.
- B. Verify that roof penetrations and plumbing stacks are in place and flashed to deck surface.
- C. Verify roof openings are correctly framed.

- D. Verify deck surfaces are dry, free of ridges, warps, or voids.

### **3.02 PREPARATION**

- A. Broom clean deck surfaces before installing underlayment or eave protection.
- B. Install eave edge and gable edge flashings tight with fascia boards. Weather lap joints 2 inches (50 mm) and seal with plastic cement. Secure flange with nails spaced at intervals recommended by NRCA.

### **3.03 INSTALLATION - EAVE PROTECTION MEMBRANE**

- A. See details and plans on drawings for extent of eave protection membrane application. Install membrane over all areas that are less than 4:12 slope.
- B. Install eave protection membrane in accordance with manufacturer's instructions.
- C. Do not leave eave protection membrane installed and exposed to weather for more than 14 days.
- D. If adhesion to sheathing does not comply to manufacturer's recommendation, prime surface with manufacturer's primer. Refer to the manufacturers' technical literature.

### **3.04 INSTALLATION - UNDERLAYMENT**

- A. Underlayment At Roof Slopes Greater Than 4:12 (At Roof Slopes Greater Than 1:3): Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum 4 inches (100 mm). Stagger end laps of each consecutive layer. Nail in place. Weather lap minimum 4 inches (100 mm) over eave protection.
- B. Items projecting through or mounted on roof: Weather lap and seal watertight with plastic cement.

### **3.05 INSTALLATION - VALLEY PROTECTION**

- A. Install valley protection in accordance with SMACNA Architectural Sheet Metal Manual Details .
- B. At Exposed Valleys: Install one layer of sheet metal flashing, minimum 24 inches (600 mm) wide, centered over open valley and crimped to guide water. Weather lap joints minimum 2 inch (50 mm) wide band of lap cement along each edge of first, press roll roofing into cement, and nail in place minimum 18 inches (450 mm) on center, 1 inch (25 mm) from edges.

### **3.06 INSTALLATION - METAL FLASHING AND ACCESSORIES**

- A. Install flashings in accordance with NRCA requirements.
- B. Weather lap joints minimum 4 inches (100 mm) and seal weather tight with plastic cement.
- C. Secure in place with nails at 12 inches (300 mm) on center. Conceal fastenings.
- D. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.

### **3.07 INSTALLATION - SHINGLES**

- A. Install shingles in accordance with manufacturer's instructions.
  - 1. Fasten individual shingles using 3 nails per shingle, or as required for wind warranty, or as required by code, whichever is greater.

2. Fasten strip shingles using 4 nails per strip, or as required for wind warranty, or as required by code, whichever is greater.
- B. Place shingles in straight coursing pattern with 5 inch (125 mm) weather exposure to produce double thickness over full roof area. Using starter strip, Provide double course of shingles at eaves.
- C. Project first course or starter strip of shingles 3/4 inch (19 mm) beyond fascia boards supported by metal edge trim.
- D. Extend shingles 1/2 inch (13 mm) beyond face of gable edge fascia boards supported by metal edge trim.
- E. Follow NRCA Recommendations for 'OPEN VALLEYS USING VALLEY METAL'. See NRCA Detail 20A and 20B. Valley Underlayment shall be Ice Dam Membrane.
- F. Step Flash at all Roof-Wall Junctions. Turn up underlayment 18 inches up wall. Follow NRCA Recommendations for 'Flashings Against Vertical Walls'. See NRCA Details 23, 24, 25, and 26.
- G. Complete installation to provide weather tight service.

### **3.08 PROTECTION**

- A. Do not permit traffic over finished roof surface.

### **END OF SECTION**





## **SECTION 07 4633 - PLASTIC SIDING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Vinyl siding and trim.
- B. Thermoplastic polyolefin shingles.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 2500 - Weather Barriers: Weather barrier under siding.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM D3679 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Siding; 2013.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Samples: Provide samples in colors specified, not less than 12 inches (305 mm) in length.

#### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Not less than three years of experience with products 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 requirements of local authorities having jurisdiction.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
- B. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 MATERIALS**

- A. General Requirements:
  - 1. Siding: Comply with ASTM D3679.
- B. Horizontal Vinyl Siding <VINYL SIDING-1>:

1. Basis of Design: Certaineed Wolverine American Legend.
  2. Profile: Dutchlap, Double 4-1/2-Inch; 4-1/2 inches (114 mm) wide; 9 inch (229 mm) exposure.
  3. Thickness: 0.042 inch (1.07 mm), minimum.
  4. Finish: Woodgrain.
  5. Color: Savannah Wicker.
- C. <VINYL SIDING-2> Shingles: Injection molded simulated cedar shingles made from thermoplastic polyolefin, complying with ASTM D3679 except for material composition.
1. Basis of Design: Certaineed Cedar Impressions D7" Straight Edge Perfection Shingles.
  2. Profile: Perfection style shingles; 48 by 14 inches (1219 by 356 mm) double course panels.
  3. Thickness: 0.10 inch (2.54 mm), minimum.
  4. Color: Hearthstone.
- D. Accessories: Provide coordinating accessories made of same material as required for complete and proper installation whether or not specifically indicated on the drawings.
1. Color: Match adjacent siding or soffit panels.
  2. Length:
    - a. Corner Posts: 10 feet (3050 mm), minimum.
    - b. Other Trim: 12.5 feet (3800 mm), minimum.
  3. Profiles: Provide types as indicated on drawings.
- E. Fasteners: Aluminum nails, alloy 5056 or 6110, with minimum tensile strength of 63,000 pounds per square inch (434 MPa); length as required to penetrate framing at least 3/4 inch (19 mm).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrate conditions before beginning installation; verify dimensions and acceptability of substrate.
- B. Verify that weather barrier has been installed over substrate completely and correctly.
- C. Do not proceed with installation until unacceptable conditions have been corrected.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 INSTALLATION**

- A. Install siding, soffit, and trim in accordance with manufacturer's printed installation instructions.
- B. Attach securely to framing, not sheathing, with horizontal components true to level and vertical components true to plumb, providing a weather resistant installation.
- C. Clean dirt from surface of installed products, using mild soap and water.

### **3.03 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**

## **SECTION 07 5300 - ELASTOMERIC MEMBRANE ROOFING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Elastomeric roofing membrane, adhered conventional application.
- B. Insulation, tapered.
- C. Flashings.
- D. Roofing cant strips and stack boots.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Wood nailers and curbs.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2015a).
- C. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2012).
- D. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2014.
- E. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- G. FM DS 1-28 - Wind Design; 2007.
- H. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, and fasteners.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and paver layout.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

### **1.05 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 the work of this section with minimum three years documented experience.

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

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture.
- C. Protect foam insulation from direct exposure to sunlight.

### **1.07 FIELD CONDITIONS**

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C) or above 100 degrees F (38 degrees C).
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

### **1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- D. Provide 20 year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. EPDM Membrane Materials:
  - 1. Carlisle Roofing Systems, Inc; Sure-Seal EPDM: [www.carlisle-syntec.com](http://www.carlisle-syntec.com).
  - 2. Firestone Building Products, LLC: [www.firestonebpco.com](http://www.firestonebpco.com).
  - 3. GenFlex Roofing Systems, LLC: [www.genflex.com](http://www.genflex.com).
  - 4. Versico, a division of Carlisle Construction Materials Inc; VersiGard EPDM: [www.versico.com/sle](http://www.versico.com/sle).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

- B. Insulation:
  - 1. Dow Chemical Company: [www.dow.com](http://www.dow.com).
  - 2. GAF: [www.gaf.com/sle](http://www.gaf.com/sle).
  - 3. Hunter Panels, LLC: [www.hpanels.com](http://www.hpanels.com).
  - 4. Owens Corning Corporation: [www.owenscorning.com](http://www.owenscorning.com).
  - 5. Insulation manufactured by the membrane manufacturer is approved.
  - 6. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 ROOFING - UNBALLASTED APPLICATIONS

- A. Elastomeric Membrane Roofing <EPDM-2>: One ply membrane, fully adhered, over insulation.
- B. Roofing Assembly Requirements:
  - 1. Roof Covering External Fire Resistance Classification: UL (DIR) certified Class A.
  - 2. Factory Mutual Classification: Class I and windstorm resistance of I-75, in accordance with FM DS 1-28.
- C. Acceptable Insulation Types - Constant Thickness Application: Any of the types specified.
  - 1. Minimum 2 layers of polyisocyanurate board.
- D. Acceptable Insulation Types - Tapered Application: Any of the types specified.
  - 1. Tapered polyisocyanurate board.

## 2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Membrane: Ethylene-propylene-diene-terpolymer (EPDM); non-reinforced; complying with minimum properties of ASTM D4637.
  - 1. Thickness: 0.060 inch (1.5 mm).
  - 2. Color: Black.
  - 3. Tensile Strength: 1,400 psi (10.0 MPa), measured in accordance with ASTM D412.
  - 4. Ultimate Elongation: 300 percent, measured in accordance with ASTM D412.
  - 5. Tear Strength: 150 lbf/in (26.3 kN/m), measured in accordance with ASTM D624.
  - 6. Water Vapor Permeability: 0.5 perm inch (0.33 ng/(Pa s m)), measured in accordance with ASTM E96/E96M.
  - 7. Brittleness Temperature: -49 degrees F (-45 degrees C), measured in accordance with 1.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Flexible Flashing Material: Same material as membrane; conforming to the following:
  - 1. Thickness: 60 mil (1.5 mm).
  - 2. Color: Black.

## 2.04 INSULATION

- A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 2 and with the following characteristics:
  - 1. System Identification:
    - a. <INSUL-53>: Tapered insulation over roof deck; no constant thickness insulation.
  - 2. Compressive Strength: 20 psi (138 kPa)
  - 3. Tapered Board: Slope as indicated; minimum thickness 1/2 inch (12.7 mm); fabricate of fewest layers possible.
  - 4. Board Edges: Square.

## **2.05 ACCESSORIES**

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. Cant and Edge Strips: Wood fiberboard, compatible with roofing materials; cants formed to 45 degree angle.
- C. Membrane Adhesive: As recommended by membrane manufacturer.
- D. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- F. Insulation Adhesive: As recommended by insulation manufacturer.
- G. Sealants: As recommended by membrane manufacturer.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

### **3.02 WOOD DECK PREPARATION**

- A. Verify flatness and tightness of joints of wood decking. Fill knot holes with latex filler.
- B. Confirm dry deck by moisture meter with 12 percent moisture maximum.

### **3.03 INSULATION - UNDER MEMBRANE**

- A. Attachment of Insulation: Embed insulation in adhesive in full contact, in accordance with roofing and insulation manufacturers' instructions.
- B. Lay subsequent layers of insulation with joints staggered minimum 6 inch (150 mm) from joints of preceding layer.
- C. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- D. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

- E. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches (450 mm).
- F. Do not apply more insulation than can be covered with membrane in same day.

#### **3.04 MEMBRANE APPLICATION**

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate at manufacturer's recommended rate. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (75 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. At intersections with vertical surfaces:
  - 1. Extend membrane over cant strips and up a minimum of 4 inches (100 mm) onto vertical surfaces.
  - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Coordinate installation of roof drains and sumps and related flashings.

#### **3.05 CLEANING**

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by work of this section.

#### **3.06 PROTECTION**

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

### **END OF SECTION**





## **SECTION 07 6200 - SHEET METAL FLASHING AND TRIM**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, soffits, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.
- C. Precast concrete splash pads.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 07 9200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

#### **1.03 REFERENCE STANDARDS**

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012).
- E. CDA A4050 - Copper in Architecture - Handbook; current edition.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

#### **1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

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

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

- B. Prevent contact with materials that could cause discoloration or staining.

## **PART 2 PRODUCTS**

### **2.01 SHEET MATERIALS**

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239 inch) (0.61 mm) thick base metal.
- B. Pre-Finished Galvanized Steel <SMF-#>: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, 0.0276 inch (0.7 mm) thick base metal, unless noted otherwise, shop pre-coated with PVDF coating.
  - 1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
  - 2. Color:
    - a. <SMF-1>: EDCO Steel Entex Desert Tone.
    - b. <SMF-2>: EDCO Steel Entex Black.
- C. <RF VENT-2>: Vented soffit panels. Basis of Design: EDCO Steel Entex; white.

### **2.02 FABRICATION**

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

### **2.03 GUTTER AND DOWNSPOUT FABRICATION**

- A. Gutters: SMACNA (ASMM), Rectangular profile.
- B. Downspouts: Rectangular profile, open face.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
- D. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.
- E. Downspout Boots: Plastic.
- F. Seal metal joints.

## **2.04 ACCESSORIES**

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Plastic Cement: ASTM D4586/D4586M, Type I.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

### **3.02 PREPARATION**

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

### **3.03 INSTALLATION**

- A. Insert flashings into reglets to form tight fit. Secure in place with lead wedges. Seal flashings into reglets with sealant.
- B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.
- F. Secure gutters and downspouts in place with concealed fasteners.
- G. Connect downspouts to downspout boots, and grout connection watertight.
- H. Set splash pads under downspouts.

## **END OF SECTION**



# **SECTION 07 8400 - FIRESTOPPING**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

### **1.02 REFERENCE STANDARDS**

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- C. ITS (DIR) - Directory of Listed Products; current edition.
- D. FM (AG) - FM Approval Guide; current edition.
- E. UL (FRD) - Fire Resistance Directory; current edition.

### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Certificate from authority having jurisdiction indicating approval of materials used.
- F. Installer Qualification: Submit qualification statements for installing mechanics.

### **1.04 QUALITY ASSURANCE**

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
  - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
  - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. With minimum 3 years documented experience installing work of this type.
  - 2. Licensed by authority having jurisdiction.

- D. Firestop sealants upon curing, shall not re-emulsify, dissolve, leach, breakdown or otherwise be damaged over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic in a building's normal operating life.
- E. Firestop sealants selected shall be sufficiently flexible to accommodate motion such as pipe vibration, water-hammer, thermal expansion, and other normal building movement, without damage to the seal.
- F. One manufacturer shall supply all firestopping material to the extent possible.
- G. All firestop materials shall be installed prior to expiration of shelf life.

#### **1.05 COORDINATION**

- A. Schedule firestopping after installation of penetrants, but prior to concealing the openings.
- B. Firestopping shall precede gypsum board finishing.

#### **1.06 FIELD CONDITIONS**

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

### **PART 2 PRODUCTS**

#### **2.01 FIRESTOPPING - GENERAL REQUIREMENTS**

- A. Manufacturers:
  - 1. A/D Fire Protection Systems Inc.: [www.adfire.com](http://www.adfire.com).
  - 2. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop).
  - 3. Hilti, Inc: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
  - 4. Nelson FireStop Products: [www.nelsonfirestop.com](http://www.nelsonfirestop.com).
  - 5. Specified Technologies, Inc.: [www.stifirestop.com](http://www.stifirestop.com).
  - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- C. Fire Ratings: Refer to drawings for required systems and ratings.

#### **2.02 FIRESTOPPING SYSTEMS**

- A. Firestopping <FR STOP>: Any material meeting requirements.
  - 1. Fire Ratings: Use any system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814 or ASTM E119 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

## **PART 3 EXECUTION**

### **3.01 CONDITIONS REQUIRING FIRESTOPPING**

- A. General: Provide firestopping for conditions specified whether or not firestopping is indicated, and if indicated, whether such materials designated as insulation, safing, or otherwise.
- B. Through-Penetration: Firestopping shall be installed in all open penetrations and in the annular space in all penetrations in any bearing or non-bearing fire-rated barrier.
- C. Membrane-Penetration: Where required by code, all membrane-penetrations in rated walls shall be protected with firestopping products that meet the requirements of third party time/temperature testing.
- D. Construction Joints/Gaps: Firestopping shall be provided at all fire rated walls as indicated on project drawings.
  - 1. Between the tops of walls and the underside of floors.
  - 2. In expansion joints at fire rated walls.
  - 3. In any penetration through fire rated wall, fill gaps and spaces with fire stopping material sufficient to maintain intended wall rating.
  - 4. Smoke-Stopping: As required by the other sections, smoke-stops shall be provided for through-penetrations, membrane-penetrations, and construction gaps with a material approved and tested for such application.

### **3.02 EXAMINATION**

- A. Verify openings are ready to receive the work of this section.

### **3.03 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to arrest liquid material leakage.

### **3.04 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

### **3.05 MARKING AND IDENTIFICATION**

- A. Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling. Such identification shall:
  - 1. Be located in accessible concealed floor, floor-ceiling or attic spaces;

2. Be located within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the wall or partition; and
3. Include lettering not less than 3 inches (76 mm) in height with a minimum 3/8 inch (9.5 mm) stroke in a contrasting color incorporating the suggested wording. "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS" or other wording.

### **3.06 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

### **3.07 PROTECTION**

- A. Protect adjacent surfaces from damage by material installation.

## **END OF SECTION**



# **SECTION 07 9200 - 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 07 1300 - Sheet Waterproofing: Sealing cracks and joints in waterproofing substrate surfaces using materials specified in this section.
- B. Section 07 2500 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
- C. Section 07 8400 - Firestopping: Firestopping sealants.
- D. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- E. Section 09 3000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

### **1.03 REFERENCE STANDARDS**

- A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2015a.
- B. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).
- H. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015.

### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes 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.
- 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.

### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of experience.
- B. 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 to manufacturer sufficient samples for testing.
  5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
  6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

### **1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
1. BASF Construction Chemicals-Building Systems: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com).
  2. Dow Corning Corporation: [www.dowcorning.com/construction](http://www.dowcorning.com/construction).
  3. Hilti, Inc: [www.us.hilti.com](http://www.us.hilti.com).
  4. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com](http://www.momentive.com).
  5. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  6. Tremco Global Sealants: [www.tremcosealants.com](http://www.tremcosealants.com).
  7. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  8. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  9. W.R. Meadows, Inc: [www.wrmeadows.com](http://www.wrmeadows.com).

10. Substitutions: See Section 01 6000 - Product Requirements.
- B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
  1. BASF Construction Chemicals-Building Systems: [www.buildingsystems.basf.com](http://www.buildingsystems.basf.com).
  2. Dow Corning Corporation: [www.dowcorning.com/construction](http://www.dowcorning.com/construction).
  3. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  4. Tremco Global Sealants: [www.tremcosealants.com](http://www.tremcosealants.com).
  5. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  6. Sika Corporation: [www.usa-sika.com](http://www.usa-sika.com).
  7. W.R. Meadows, Inc: [www.wrmeadows.com](http://www.wrmeadows.com).
  8. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
  1. Exterior Joints: Seal open joints, whether or not the joint is indicated on the drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    - a. Wall expansion and control joints.
    - b. Joints between door, window, and other frames and adjacent construction.
    - c. Joints between different exposed materials.
    - d. Openings below ledge angles in masonry.
    - e. Other joints indicated below.
  2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. Other joints indicated below.
  3. Do not seal the following types of joints.
    - a. Intentional weepholes in masonry.
    - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    - d. Joints where installation of sealant is specified in another section.
    - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
  1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
  1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
  2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
  3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
  4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
  5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
  6. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
  7. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

- D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

### **2.03 JOINT SEALANTS - GENERAL**

- A. Material ID's:
  - 1. <SEALANT-1>: Provide a joint sealant. Type as indicated above.
  - 2. <SEALANT-2>: Provide a backer rod and joint sealant. Type as indicated above.

### **2.04 NONSAG JOINT SEALANTS**

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
  - 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
  - 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
  - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
  - 4. Color: To be selected by Architect from manufacturer's standard range.
  - 5. Cure Type: Single-component, neutral moisture curing.
  - 6. Service Temperature Range: Minus 65 to 180 degrees F (Minus 54 to 82 degrees C).
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
  - 1. Color: White.
- C. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
  - 1. Color: To be selected by Architect from manufacturer's standard range.
  - 2. Grade: ASTM C834; Grade - Minus 18 Degrees C.

### **2.05 SELF-LEVELING SEALANTS**

- A. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
  - 1. Composition: Multi-component, 100 percent solids by weight.
  - 2. Hardness: Minimum of 85 (Shore A) or 35 (Shore D), when tested in accordance with ASTM D2240 after 7 days.
  - 3. Color: To be selected by Architect from manufacturer's standard colors.
  - 4. Joint Width, Minimum: 1/8 inch (3 mm).
  - 5. Joint Width, Maximum: 1/4 inch (6 mm).
  - 6. Joint Depth: Provide product suitable for joints from 1/8 inch (3 mm) to 2 inches (51 mm) in depth including space for backer rod.

### **2.06 ACCESSORIES**

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
  2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
  3. Open Cell: 40 to 50 percent larger in diameter than joint width.
  4. Closed Cell and Bi-Cellular: 25 to 33 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. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

### **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.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- 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.
- H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

**END OF SECTION**

## **SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 7100 - Door Hardware.
- B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 9113 - Exterior Painting: Field painting.
- D. Section 09 9123 - Interior Painting: Field painting.

#### **1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (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; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. 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; 2014.
- H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

- J. ITS (DIR) - Directory of Listed Products; current edition.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- N. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- P. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).
- Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes installation requirements.

#### **1.06 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 or Curries, an Assa Abloy Group company: [www.assaabloydss.com](http://www.assaabloydss.com).
  - 2. Republic Doors: [www.republicdoor.com](http://www.republicdoor.com).
  - 3. Steelcraft, an Allegion brand: [www.allegion.com/us](http://www.allegion.com/us).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.



## 2.02 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to 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: Manufacturers 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.
    - a. Provide minimum 3/16" plate steel as reinforcement for hardware. If the manufacturer's standard is for a greater thickness at specific locations, provide the thicker of the two standards.
  8. Electrified Hardware Preparation:
    - a. Provide electrical conduit and junction-boxes as required for electric power and signal routing and for electrical terminations as required to support electrical and electronic hardware indicated in Section 08 7100.
    - b. Secure conduit and boxes to the frame and doors. Extend conduit attached to frames 12 inches above frame for connection to conduit furnished by other sections.
    - c. Coordinate locations of conduit and boxes with Section 08 7100.
- 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. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 3 - Extra Heavy-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 2 - Seamless.
    - d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
    - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  2. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
  3. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 3 - Extra Heavy-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 2 - Seamless.
    - d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.

2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.
  3. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
- C. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 3 - Extra Heavy-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 2 - Seamless.
    - d. Door Face Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
  2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
    - a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
    - b. Attach fire rating label to each fire rated unit.
  3. Core Material: Manufacturers standard core material/construction in compliance with requirements.
  4. Door Thickness: 1-3/4 inch (44.5 mm), nominal.

#### **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. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
  1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
  2. Frame Metal Thickness: 14 gage, 0.067 inch (1.7 mm), minimum.
  3. Weatherstripping: Separate, see Section 08 7100.
- D. Interior Door Frames, Non-Fire Rated: Face welded type.
  1. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum; except 14 gage, 0.067 inch (1.7 mm) for masonry applications.
- E. Door Frames, Fire-Rated: Face welded type.
  1. Fire Rating: Same as door, labeled.
  2. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum; except 14 gage, 0.067 inch (1.7 mm) for masonry applications.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- I. Frames Wider than 48 Inch (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

## **2.05 ACCESSORIES**

- A. Glazing: As specified in Section 08 8000.
- B. Grout for Frames: Portland cement grout with maximum 4 inch (102 mm) slump for hand troweling; thinner pumpable grout is prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

## **2.06 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- 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.

### **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. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of hardware.
- F. Coordinate installation of glazing.
- G. Coordinate installation of electrical connections to electrical hardware items.

### **3.04 TOLERANCES**

- A. Clearances Between Door and Frame: Comply with related requirements of specified door and frame standards or custom guidelines indicated.
- B. Maximum Diagonal Distortion: 1/16 in (1.5 mm) measured with straight edge, corner to corner.

### **3.05 ADJUSTING**

- A. Adjust for smooth and balanced door movement.

**END OF SECTION**

## **SECTION 08 1213 - HOLLOW METAL FRAMES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.
- B. Fire-rated hollow metal frames for non-hollow metal doors.
- C. Interior glazed borrowed lite frames.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 7100 - Door Hardware: Hardware and weatherstripping.
- B. Section 09 9113 - Exterior Painting: Field painting.
- C. Section 09 9123 - Interior Painting: Field painting.

#### **1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (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; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. 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; 2014.
- H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- J. ITS (DIR) - Directory of Listed Products; current edition.
- K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.

- M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- N. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- O. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

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

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Hollow Metal Frames with Applied Casings, Prefinished:
  - 1. Dunbarton Corporation, Inc; Product: " Rediframe" [www.dunbarton.com](http://www.dunbarton.com) (Basis of Design).
  - 2. Timely Industries, Inc; [www.timelyframes.com](http://www.timelyframes.com).

#### **2.02 DESIGN CRITERIA**

- A. Door Frame Type: Provide hollow metal door frames with integral casings.
- B. Steel used for fabrication of frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
- C. Accessibility: Comply with ICC A117.1 and ADA Standards.
- D. 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 frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.

- E. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830 and NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- F. Zinc Coating for Units Subject to Corrosive Conditions: 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.
- G. Frames for Interior Glazing or Borrowed Lites: Construction and face dimensions to match door frames, and as indicated on drawings.

### **2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS**

- A. Exterior Door Frames: Full profile/continuously welded type.
  - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 3 - Extra Heavy-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum.
    - d. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  - 2. Frame Finish: Factory primed and field finished.
  - 3. Weatherstripping: Refer to Section 08 7100.
- B. Interior Door Frames, Non-Fire Rated: Face welded type.
  - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-duty. (Except Level 3 - Extra Heavy-duty for frames in masonry openings.)
    - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum. (Except 14 gage, 0.067 inch (1.7 mm) for frames in masonry openings.)
  - 2. Frame Finish: Factory primed and field finished.
- C. Fire-Rated Door Frames: Face welded type.
  - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 2 - Heavy-duty. (Except Level 3 - Extra Heavy-duty for frames in masonry openings.)
    - b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Frame Metal Thickness: 16 gage, 0.053 inch (1.3 mm), minimum. (Except 14 gage, 0.067 inch (1.7 mm) for frames in masonry openings.)
  - 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C or NFPA 252 ("positive pressure fire tests").
  - 3. Temperature-Rise Rating (TRR) Across Framed Door Thickness: In accordance with local building code and authorities having jurisdiction.
    - a. Provide units listed and labeled by ITS (DIR) or UL (DIR).
    - b. Attach fire rating label to each fire rated unit.
  - 4. Frame Finish: Factory primed and field finished.

### **2.04 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

### **2.05 ACCESSORIES**

- A. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

- B. Grout for Frames: Portland cement grout with maximum 4 inch (102 mm) slump for hand troweling; thinner pumpable grout is prohibited.
- C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

## **2.06 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- 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.

### **3.03 INSTALLATION**

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Coordinate installation of glazing.
- F. Coordinate installation of hardware.
- G. Coordinate installation of electrical connections to electrical hardware items.

### **3.04 TOLERANCES**

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated.
- B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edges, crossed corner to corner.

## **END OF SECTION**



## **SECTION 08 1416 - FLUSH WOOD DOORS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 1113 - Hollow Metal Doors and Frames.
- B. Section 08 1450 - Prehung Wood Doors: Unit interior doors.
- C. Section 08 7100 - Door Hardware.
- D. Section 08 8000 - Glazing.

#### **1.03 REFERENCE STANDARDS**

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit two samples of door veneer, 6 by 6 inch (152 by 152 mm) in size illustrating wood grain, stain color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special installation instructions.
- F. Warranty, executed in Owner's name.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

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

- A. Package, deliver and store doors in accordance with specified quality standard.

- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

### **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
  1. Algoma Hardwoods: [www.algomahardwoods.com](http://www.algomahardwoods.com).
  2. Eggers Industries: [www.eggersindustries.com](http://www.eggersindustries.com).
  3. Graham Wood Doors: [www.grahamdoors.com](http://www.grahamdoors.com).
  4. Lyndon Door, Inc: [www.lyndendoor.com](http://www.lyndendoor.com).
  5. Marshfield DoorSystems, Inc: [www.marshfielddoors.com](http://www.marshfielddoors.com).
  6. VT Industries, Inc: [www.vtindustries.com](http://www.vtindustries.com).
  7. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 DOORS**

- A. Doors: Refer to drawings for locations and additional requirements.
  1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
  2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
  1. Provide solid core doors at each location.
  2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
  3. Wood veneer faced doors: Legacy finish with maple look.
  4. Common area doors flush solid.
  5. Unit entry doors flush solid core. Provide with three-panel trim applied to corridor side only.

### **2.03 DOOR AND PANEL CORES**

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

## **2.04 DOOR FACINGS**

- A. Legacy finish with maple look.

## **2.05 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
  - 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
  - 2. Provide solid blocking for other throughbolted hardware.
- C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Use machine tools to cut or drill for hardware.
- C. Coordinate installation of doors with installation of frames and hardware.

### **3.03 TOLERANCES**

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

### **3.04 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

**END OF SECTION**

## **SECTION 08 1450 - PREHUNG WOOD DOORS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Hollow core wood doors; six panel configuration; non-rated, prehung in wood frames.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 2000 - Finish Carpentry: Wood casing trim.
- B. Section 08 7100 - Door Hardware.
- C. Section 09 9000 - Painting and Coating: Site finishing of doors.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, cutouts for glazing and other details.
- D. Specimen warranty.
- E. Samples: Submit two samples of door veneer, 6 by 6 inch (152 by 152 mm) in size illustrating wood grain, stain color, and sheen.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Warranty, executed in Owner's name.

#### **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, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

#### **1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for 1 year.

- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Wood Prehung Doors:
  - 1. Lynden Door, Inc: [www.lyndendoor.com](http://www.lyndendoor.com).
  - 2. Smith & DeShields; CraftMaster: [www.smithanddeshields.com](http://www.smithanddeshields.com).
  - 3. Masonite International: [www.masonite.com](http://www.masonite.com).
  - 4. Pinecrest: [www.pinecrest.com](http://www.pinecrest.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 DOORS**

- A. Unit Interior Doors: 1-3/8 inches (35 mm) thick unless otherwise indicated.
  - 1. Wood veneer faced doors: Legacy finish with maple look.

### **2.03 DOOR AND PANEL CORES**

- A. Hollow Core Doors: Type Standard (SHC/FSHC); plies and faces as indicated above.

### **2.04 DOOR FACINGS**

### **2.05 DOOR FRAMES**

- A. Door Frames:
  - 1. Jamb: Wood jambs shall be fabricated as a flat jamb with doorstop applied or 2-piece split jamb.
  - 2. Hinge Jamb: Prepare for 1-3/4 inch thick doors. Machine for 4-1/2 inch hinges.
  - 3. Strike jamb preparations are to be machined for full lip cylindrical strike plate.
- B. Hardware:
  - 1. Hinges: Manufacturers standard hinges. Provide 3 for doors up to 7'-0" or less, 4 for taller doors.
    - a. Finish: Oil rubbed bronze.
  - 2. All other hardware by Section 08 7100.

### **2.06 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
  - 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
  - 2. Provide solid blocking for other throughbolted hardware.
- C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Provide edge clearances in accordance with the quality standard specified.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

### **3.02 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
- B. Use machine tools to cut or drill for hardware.
- C. Coordinate installation of prehung doors with installation of hardware.

### **3.03 TOLERANCES**

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

### **3.04 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

## **END OF SECTION**





## **SECTION 08 3100 - ACCESS DOORS AND PANELS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Wall access door and frame units.
- B. Ceiling access door and frame units.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 09 9123 - Interior Painting: Field paint finish.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.

### **PART 2 PRODUCTS**

#### **2.01 ACCESS DOOR AND PANEL APPLICATIONS**

- A. Walls, Unless Otherwise Indicated:
  - 1. Material: Steel.
  - 2. Size: 12 by 12 inch (305 by 305 mm), unless otherwise indicated.
  - 3. Standard duty, hinged door.
  - 4. Tool-operated spring or cam lock; no handle.
  - 5. In Gypsum Board: Drywall bead frame with door surface flush with wall surface.
  - 6. In Masonry: Frameless with door surface recessed for infill with wall finish.
- B. Walls in Wet Areas:
  - 1. Material: Steel, hot-dipped zinc or zinc-aluminum-alloy coated.
  - 2. Size: 12 by 12 inch (305 by 305 mm), unless otherwise indicated.
  - 3. Standard duty, hinged door.
  - 4. In Gypsum Board: Drywall bead frame with door surface flush with wall surface.
  - 5. In Masonry: Surface mounted frame with door surface flush with frame surface.
- C. Fire Rated Walls: See drawings for wall fire ratings.
  - 1. Material: Steel.
  - 2. Size: 12 by 12 inch (305 by 305 mm), unless otherwise indicated.
  - 3. Tool-operated spring or cam lock; no handle.
- D. Ceilings, Unless Otherwise Indicated: Same type as for walls.
  - 1. Size in Lay-in Grid Ceilings: To match grid module.
  - 2. Size in Other Ceilings: 12 by 12 inch (305 by 305 mm), unless otherwise indicated.
  - 3. Standard duty, hinged door.

4. Tool-operated spring or cam lock; no handle.

## **2.02 WALL AND CEILING UNITS**

- A. Manufacturers:
  1. ACUDOR Products Inc: [www.acudor.com](http://www.acudor.com).
  2. Babcock-Davis: [www.babcockdavis.com](http://www.babcockdavis.com).
  3. Cendrex, Inc: [www.cendrex.com/sle](http://www.cendrex.com/sle).
  4. Karp Associates, Inc: [www.karpinc.com](http://www.karpinc.com).
  5. Milcor, Inc: [www.milcorinc.com](http://www.milcorinc.com).
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Door and Frameless Units <ACC PNL-1>: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
  1. Style: Exposed frame with door surface flush with frame surface.
    - a. In Gypsum Board: Use drywall bead type frame.
  2. Door Style: Single thickness with rolled or turned in edges.
  3. Frames: 16 gage, 0.0598 inch (1.52 mm), minimum.
  4. Single Thickness Steel Door Panels: 1/16 inch (1.6 mm), minimum.
  5. Units in Fire Rated Assemblies: Fire rating as required by applicable code for the fire rated assembly that access doors are being installed.
  6. Steel Finish: Primed.
  7. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
  8. Size: As scheduled above unless otherwise indicated in the drawings.
  9. Hardware:
    - a. Hardware for Fire Rated Units: As required for listing.
    - b. Hinges for Non-Fire-Rated Units: Continuous piano hinge.
    - c. Latch/Lock: Screw driver slot for quarter turn cam latch.
- C. <ACC PNL-2>, 24" x 36" fire rated insulated drywall access door. Basis of Design: BA-PFI-GyP by Best Access Door.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.

### **3.02 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

## **END OF SECTION**

## **SECTION 08 3613 - 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 RELATED REQUIREMENTS**

- A. Section 05 5000 - Metal Fabrications: Steel channel opening frame.
- B. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

#### **1.03 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; 2015.
- B. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- C. DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors; 2011.
- D. NEMA MG 1 - Motors and Generators; 2014.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- 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 3000 - 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. Manufacturer's Installation Instructions: Include any special procedures required by project conditions.
- E. Operation Data: Include normal operation, troubleshooting, and adjusting.
- F. Maintenance Data: Include data for motor and transmission, shaft and gearing, lubrication frequency, spare part sources.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

## 1.05 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 type specified and with at least three years documented experience.
- C. Conform to applicable code for motor and motor control requirements.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified.

## 1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for electric motor and transmission.
- D. Provide five year manufacturer warranty for electric operating equipment.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Sectional Doors:
  - 1. Basis of Design: C.H.I. Overhead Doors; Model 3216 Micro-Grooved Sandwich Steel Insulated Doors: [www.chiohd.com/sle](http://www.chiohd.com/sle).
  - 2. Overhead Door Corporation: [www.overheaddoor.com](http://www.overheaddoor.com).
  - 3. Clopay Building Products: [www.clopaydoor.com/sle](http://www.clopaydoor.com/sle).
  - 4. Wayne-Dalton, a Division of Overhead Door Corporation: [www.wayne-dalton.com](http://www.wayne-dalton.com).
  - 5. Raynor Garage Doors: [www.raynor.com](http://www.raynor.com).
  - 6. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 STEEL DOOR COMPONENTS

- A. Steel Doors: Flush steel, insulated; standard lift operating style with track and hardware; complying with DASMA 102, Commercial application.
  - 1. Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
  - 2. Door Nominal Thickness: 2 inches (51 mm) thick.
  - 3. Exterior Finish: Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.
  - 4. Interior Finish: Factory finished with acrylic baked enamel; color as selected from manufacturers standard line.
  - 5. R-Value: Minimum R-17.5.
  - 6. Operation: Electric.
- B. Door Panels: Steel construction; outer steel sheet of 27 gage, 0.0164 inch (0.42 mm) minimum thickness, flush profile; inner steel sheet of 27 gage, 0.0164 inch (0.42 mm) minimum thickness, flat

profile; core reinforcement sheet steel roll formed to channel shape, rabbeted weather joints at meeting rails; polyurethane insulation.

### **2.03 DOOR COMPONENTS**

- A. Track: Rolled galvanized steel, 0.090 inch (2.3 mm) minimum thickness; 3 inch (75 mm) wide, continuous one piece per side; galvanized steel mounting brackets 1/4 inch (6 mm) thick.
- B. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; floating hardened steel bearing rollers, located at top and bottom of each panel, each side.
- C. Lift Mechanism: Torsion spring on cross head shaft, with braided galvanized steel lifting cables. Provide high cycle springs; minimum 100,000 cycles.
- D. Sill Weatherstripping: Resilient hollow rubber strip, one piece; fitted to bottom of door panel, full length contact.
- E. Jamb Weatherstripping: Roll formed steel section full height of jamb, fitted with resilient weatherstripping, placed in moderate contact with door panels.
- F. Head Weatherstripping: EPDM rubber seal, one piece full length.
- G. Panel Joint Weatherstripping: Neoprene foam seal, one piece full length.
- H. Lock: Inside center mounted, adjustable keeper, spring activated latch bar with feature to retain in locked or retracted position; interior and exterior handle.

### **2.04 MATERIALS**

- A. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G60/Z180 coating, plain surface.
- B. Insulation: Foamed-in-place polyurethane, bonded to facing.

### **2.05 ELECTRICAL OPERATION**

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by a testing agency acceptable to authorities having jurisdiction.
  - 1. Operator shall be of commercial grade and rated for a minimum of 200,000 cycles.
- B. Electrical Characteristics:
  - 1. 1/2 hp (375 W); manually operable in case of power failure, transit speed of 12 inches (300 mm) per second.
- C. Motor: NEMA MG 1, Type 1.
- D. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- E. Disconnect Switch: Factory mount disconnect switch in control panel.
- F. Electric Operator: Side mounted on cross head shaft, adjustable safety friction clutch; brake system actuated by independent voltage solenoid controlled by motor starter; enclosed gear driven limit switch; enclosed magnetic cross line reversing starter; mounting brackets and hardware.

- G. Safety Edge: At bottom of door panel, full width; pneumatic sensitized type, wired to stop door upon striking object; hollow neoprene covered to provide weatherstrip seal.
- H. Provide manufacturer's standard infrared optical sensor safety feature.
- I. Control Station: Standard three button (open-close-stop) momentary type control for each electric operator.
  - 1. 24 volt circuit.
  - 2. Surface mounted.
  - 3. Locate at inside door jamb.
  - 4. Fob control to enter. vehicle pave over detection loop in floor to exit.
  - 5. Provide 75 fob control openers.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- B. Verify that electric power is available and of the correct characteristics.

### **3.02 PREPARATION**

- A. Prepare opening to permit correct installation of door unit to perimeter air and vapor barrier seal.
- B. 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.
- F. Install perimeter trim and closures.

### **3.04 TOLERANCES**

- A. Maximum Variation from Plumb: 1/16 inch (1.5 mm).
- B. Maximum Variation from Level: 1/16 inch (1.5 mm).
- C. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3 mm) from 10 ft (3 m) straight edge.
- D. Maintain dimensional tolerances and alignment with adjacent work.

### **3.05 ADJUSTING**

- A. Adjust door assembly for smooth operation and full contact with weatherstripping.
- B. Have manufacturer's field representative present to confirm proper operation and identify adjustments to door assembly for specified operation.

### **3.06 CLEANING**

- A. Clean doors and frames and glazing.
- B. Remove temporary labels and visible markings.

### **3.07 PROTECTION**

- A. Protect installed products from damage until Date of Substantial Completion.
- B. Do not permit construction traffic through overhead door openings after adjustment and cleaning.

## **END OF SECTION**





## **SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- B. Section 08 8000 - Glazing: Glass and glazing accessories.

#### **1.03 REFERENCE STANDARDS**

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 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 (Combined Document); 2015.
- D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2016).
- L. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

#### **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 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- E. 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 experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of 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 (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

#### **1.09 WARRANTY**

- A. See Section 01 7800 - 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. Front-Set Style, Thermally-Broken:
  - 1. Basis of Design: Kawneer; Trifab VG 451T.
  - 2. Basis of Design: Tubelite; 14000 I/O Series.
  - 3. Basis of Design: EFCO Corporation; Series 433, Thermal Triple-Set Storefront Framing: [www.efcocorp.com/sle](http://www.efcocorp.com/sle).
  - 4. Basis of Design: CMI Architectural; 450TB FS.
  - 5. Basis of Design: Manko; 2450FS Series.
- B. Substitutions: See Section 01 6000 - Product Requirements.
  - 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

### **2.02 BASIS OF DESIGN -- SWINGING DOORS**

- A. Medium Stile, Insulating Glazing, Not Thermally-Broken:
  - 1. Basis of Design: Kawneer; 350 Medium Stile Door.
  - 2. Basis of Design: Tubelite; Medium Stile Doors
  - 3. Basis of Design: EFCO Corporation; Series D300 Medium Stile: [www.efcocorp.com/sle](http://www.efcocorp.com/sle).
  - 4. Basis of Design: CMI Architectural; 351 Medium Stile Door.
  - 5. Basis of Design: Manko; 135 Series Medium Stile Door.
- B. Substitutions: See Section 01 6000 - Product Requirements.
  - 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

### **2.03 STOREFRONT**

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices. <ALUM STOR-1>
  - 1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
  - 2. Finish: Class I color anodized.
    - a. Factory finish all surfaces that will be exposed in completed assemblies.
  - 3. Finish Color: Black.
  - 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 (95 degrees C) 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.

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. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf (390 Pa).
3. Air Leakage: Maximum of 0.06 cu ft/min sq ft (0.3 L/sec sq m) of wall area, when tested in accordance with ASTM E283 at 6.27 psf (300 Pa) pressure differential across assembly.

## 2.04 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  1. Framing members for interior applications need not be thermally broken (except at interior locations with insulated glass).
  2. Glazing Stops: Flush.
  3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: As specified in Section 08 8000.
- C. Swing Doors: Glazed aluminum.
  1. Thickness: 1-3/4 inches (43 mm), minimum.
  2. Top Rail: 3-1/2 to 4 inches (84 to 101 mm) wide.
  3. Vertical Stiles: 3-1/2 to 4 inches (84 to 101 mm) wide.
  4. Bottom Rail: 10 inches (254 mm) wide.
  5. Glazing Stops: Square.
  6. Finish: Same as storefront.
- D. Sill Plate: Provide a subsill plate with integral front lip. Match finish of storefront system.

## 2.05 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.

- E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- F. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

## **2.06 FINISHES**

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.

## **2.07 HARDWARE**

- A. Door Hardware: As specified in Section 08 7100 - Door Hardware.
- B. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

### **3.02 INSTALLATION**

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in bed of sealant and secure.
- J. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### **3.03 TOLERANCES**

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 1/16 inches per 10 ft (1.5 mm/3 m), whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
- B. Test installed storefront for water leakage in accordance with AAMA 501.2 hose test.

### **3.05 ADJUSTING**

- A. Adjust operating hardware for smooth operation.

### **3.06 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

### **3.07 PROTECTION**

- A. Protect installed products from damage until Date of Substantial Completion.

## **END OF SECTION**

## **SECTION 08 5313 - VINYL WINDOWS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Vinyl-framed, factory-glazed windows.
- B. Operating hardware.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

#### **1.03 REFERENCE STANDARDS**

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights; 2011.
- B. AAMA 701/702 - Combined Voluntary Specifications for Pile Weatherstrip and Replaceable Fenestration Weatherseals; 2011.
- C. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2007.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene one week week before starting work of this section.
  - 1. Manufacturer's representative shall be required to attend meeting.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, anchors, fasteners, glass, and internal drainage.
- C. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work, and installation requirements.
- D. Manufacturer's Certificate: Certify that products of this section meet or exceed specified requirements.
- E. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
  - 1. Evidence of AAMA Certification.
  - 2. Evidence of WDMA Certification.
  - 3. Evidence of CSA Certification.
  - 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- F. Warranty: 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 products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing of type specified and with at least three years documented experience.

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

- A. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- B. Jig, brace, and box the window frame assemblies for transport to minimize flexing of members or joints.

## **1.08 FIELD CONDITIONS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C).
- B. Maintain this minimum temperature during and after installation of sealants.

## **1.09 MOCKUP**

- A. Provide one window installed for approval. Mockup shall include the window and associated flashing and air barriers. Remaining windows cannot be installed until mockup has been reviewed and approved by Owner, Architect, window manufacturer and air barrier manufacturer.

## **1.10 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a ten year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for degradation of color finish.

# **PART 2 PRODUCTS**

## **2.01 MANUFACTURERS**

- A. Vinyl Windows Basis of Design: Thermo-Tech Vinyl Windows and Doors; [www.ttwindows.com](http://www.ttwindows.com).
  - 1. Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 DESCRIPTION**

- A. Vinyl Windows: Factory fabricated frame and sash members of extruded, hollow, ultra-violet-resistant, polyvinyl chloride (PVC) with integral color; with factory-installed glazing, hardware, related flashings, anchorage and attachment devices.
  - 1. Configuration: As indicated on drawings.
    - a. Product Type: single hung at apartment units fixed at common areas.
  - 2. Color: Color as selected.
  - 3. Size to fit openings with minimum clearance around perimeter of assembly providing necessary space for perimeter seals.



4. Framing Members: Fusion welded corners and joints, with internal reinforcement where required for structural rigidity; concealed fasteners.
  5. System Internal Drainage: Drain to exterior side by means of weep drainage network any water entering joints, condensation within glazing channel, or other migrating moisture within system.
  6. Glazing Stops, Trim, Flashings, and Accessory Pieces: Formed of rigid PVC, fitting tightly into frame assembly.
- B. Performance Requirements: Provide products that comply with the following:
1. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
    - a. Performance Class (PC): LC.

### **2.03 COMPONENTS**

- A. Glazing: Insulated double pane, annealed glass, clear, low-E coated, argon filled, with glass thicknesses as recommended by manufacturer for specified wind conditions and acoustic rating indicated.
- B. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to maintain weather seal in accordance with AAMA 701/702.
- C. Provide stops at all operable windows where the sill is less than 40 inches above the finish floor. Stops shall prevent the passage of a 4 inch sphere through the window when fully open.
- D. Sealants for Setting Window Sill Pan Flashing: Provide butyl tape, non-hardening butyl, polyurethane, or silicone sealant; in compliance with ASTM E2112 installation practices.
- E. Sliding Patio Doors: Basis of Design Thermo-Tech Slim Line Sliding Glass doors.

### **2.04 HARDWARE**

- A. Sash lock: Lever handle and keeper with cam lock, provide at least one for each operating sash.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify wall openings and adjoining air and vapor seal materials are ready to receive this work.

### **3.02 INSTALLATION**

- A. Install window unit assemblies in accordance with manufacturers instructions and applicable building codes.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities as necessary.
- C. Align window plumb and level, free of warp or twist, and maintain dimensional tolerances and alignment with adjacent work.
- D. Set sill members and sill flashing in continuous bead of sealant.
- E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- F. Install operating hardware.

### **3.03 TOLERANCES**

- A. Maximum Variation from Level or Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 0.5 inches per 100 ft (12 mm/30 m), whichever is less.

### **3.04 ADJUSTING**

- A. Adjust hardware for smooth operation and secure weathertight closure.

### **3.05 CLEANING**

- A. Remove protective material from pre-finished surfaces.
- B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
- C. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer and appropriate for application indicated.

## **END OF SECTION**

## **SECTION 08 7100 - DOOR HARDWARE**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Hardware for wood, aluminum, and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Thresholds.
- E. Weatherstripping, seals and door gaskets.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 1113 - Hollow Metal Doors and Frames.
- B. Section 08 1416 - Flush Wood Doors.
- C. Section 08 4313 - Aluminum-Framed Storefronts: Hardware for doors in storefront, including:
  - 1. Integral weatherstripping.

#### **1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. BHMA A156.18 - American National Standard for Materials and Finishes; 2012.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- E. NFPA 101 - Life Safety Code; 2015.
- F. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Within ten days after award of contract, submit detailed hardware schedule in quantities as required by Division 01 - General Conditions.
- C. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:
  - 1. Door number, location, size, handing, and rating.
  - 2. Door and frame material, handing.
  - 3. Degree of swing.
  - 4. Manufacturer

5. Product name and catalog number
  6. Function, type and style
  7. Size and finish of each item
  8. Mounting heights
  9. Explanation of abbreviations, symbols, etc.
  10. Numerical door index, indicating the hardware set/ group number for each door.
- D. When universal type door closers are to be provided, the schedule shall indicate the application method to be used for installation at each door: (regular arm, parallel arm, or top jamb).
  - E. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed with the DHI certification seal of the supervising AHC. The supervising AHC shall attend any meetings related to the project when requested by the architect.
  - F. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.
  - G. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or incompatible items, and proposed substitutions in the hardware schedule.
  - H. Provide documentation for all hardware to be furnished on labeled fire doors indicating compliance with positive pressure fire testing UL 10C.
  - I. Furnish manufacturers' catalog data for each item of hardware in quantities as required by Division 01 - General Conditions.
  - J. Submit a sample of each type of hardware requested by the architect. Samples shall be of the same finish, style, and function as specified herein. Tag each sample with its permanent location so that it may be used in the final work.
  - K. Furnish with first submittal, a list of required lead times for all hardware items.
  - L. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities as required by Division 01 - General Conditions.
  - M. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.
  - N. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.
  - O. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner's representative to determine keying requirements. Upon completion of the initial key meeting, hardware supplier shall prepare a proposed key schedule with symbols and abbreviations as set forth in the door and hardware institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of owner approved key schedule for review and field use in quantities as required by Division 01 - General Conditions. Wiring diagrams shall be included in final submittals transmitted for distribution and field use.

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

- A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.

- B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.
- C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.
- D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.
- E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

#### **1.06 COORDINATION**

- A. Templates: Distribute door hardware templates for doors, frames, and other Work specified to be factory prepared for installing door hardware. Check Shop Drawings of other Work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system.
  - 1. Prior to installation of electronic hardware, arrange conference between door hardware, and door/frame supplier, installers and related trades to review materials, procedures and coordinating related work.

#### **1.07 PRE-INSTALLATION MEETING**

- A. Schedule a hardware pre-installation meeting on site to review and discuss the installation of continuous hinges, locksets, door closers, exit devices, overhead stops, and electromechanical door hardware.
- B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.
- C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

#### **1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. All hardware items shall be warranted against defects in material and workmanship as set forth in Division One General Requirements.
- C. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

## PART 2 PRODUCTS

### 2.01 DOOR HARDWARE - GENERAL

- A. Provide hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Provide items of a single type of the same model by the same manufacturer.
- C. Provide products that comply with the following:
  - 1. Applicable provisions of federal, state, and local codes.
  - 2. Accessibility: ADA Standards and ICC A117.1.
  - 3. Applicable provisions of NFPA 101, Life Safety Code.
  - 4. Fire-Rated Doors: NFPA 80.
  - 5. Hardware on Fire-Rated Doors, Except Hinges: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
  - 6. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.
  - 7. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.
- D. Electrically Operated and/or Controlled Hardware: Provide all power supplies, power transfer hinges, relays, and interfaces required for proper operation; provide wiring between hardware and control components and to building power connection.
- E. Finishes: Provide door hardware of the same finish unless otherwise indicated.
  - 1. Finish: Satin oxidized bronze, oil rubbed, on bronze base metal, 613 (approx US10B).
  - 2. Finish Definitions: BHMA A156.18.
  - 3. Exceptions:
    - a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
    - b. Hinges for Fire-Rated Doors: Steel base metal with painted finish.
    - c. Aluminum Surface Trim and Gasket Housings: Anodized to match door, not to match other hardware.
- F. Fasteners:
  - 1. All exposed fasteners shall be Phillips head or as otherwise specified, and shall match the finish of the adjacent hardware. All fasteners exposed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.
  - 2. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

### 2.02 HINGES

- A. Acceptable manufacturers and respective catalog numbers:

	Ives	Stanley	Hager	McKinney
Standard Weight, Plain Bearing	5PB1	F179	1279	T2714
Standard Weight, Ball Bearing	5BB1	BB179	BB1279	TB2714
Standard Weight, Ball Bearing, Non-Ferrous	5BB1	FBB191	BB1191	TB2314
Heavy Weight, Ball Bearing	5BB1HW	FBB168	BB1168	T4B3786

Heavy Weight, Ball Bearing, Non-Ferrous	5BB1HW	FBB199	BB1199	T4B3386
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- B. Quantity of Hinges Per Door:
  1. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
  2. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.
- C. Unless otherwise specified, top and bottom hinges shall be located as specified in Division 08 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.
- D. Unless otherwise specified, furnish hinge weight and type as follows:
  1. Standard weight: plain bearing hinge 5PB1 for interior openings through 36 inches wide without a door closer.
  2. Standard weight: ball bearing hinge 5BB1 for interior opening over 36 through 40 inches wide without a door closer, and for interior openings through 40 inches wide with a door closer.
  3. Heavyweight: 4 ball bearing hinge 5BB1HW for interior openings over 40 inches wide, and for all vestibule doors.
  4. Heavyweight: 4 ball bearing hinge 5BB1HWss for exterior openings unless otherwise listed in groups.
- E. Unless otherwise specified, furnish hinges for exterior doors, fabricated from brass, bronze, or stainless steel. Unless otherwise specified, hinges for interior doors may be fabricated from steel.
- F. Unless otherwise specified, furnish hinges in the following sizes:
  1. 5" x 5"                                 2-1/4" thick doors
  2. 4-1/2" x 4-1/2"                       1-3/4" thick doors
  3. 3-1/2" x 3-1/2"                       1-3/8" thick doors
- G. Furnish hinges with sufficient width to accommodate trim and allow for 180-degree swing.
- H. Unless otherwise specified, furnish hinges with flat button tips with non-rising pins at interior doors, non-removable loose pins (NRP) at exterior and out-swinging interior doors.
- I. Unless otherwise specified, furnish all hinges to template standards.

**2.03 SPRING HINGES**

- A. Self-Closing Hinges: Comply with ANSI/BHMA A156.17. Listed under Category A in BHMA's "Certified Product Directory."
  1. Provide UL fire tested and listed hinges for labeled doors up to and including Class "A." Comply with NFPA 80 requirements for spring hinges on fire-rated doors.
  2. Acceptable Manufacturers:

	Bommer	Hager	McKinney	Stanley	Ives	PBB
(0.134) Steel	LB4310	1250	1502	2060R	3SP1	RS81
(0.134) Stainless	LB4390	1150	1552	2060R	3SP1	BB81

- 3. Substitutions: See Section 01 6000 - Product Requirements.

**2.04 CONTINUOUS PIN AND BARREL HINGES**

- A. Acceptable manufacturers and respective catalog numbers:

	Ives	Markar	Stanley	McKinney
Edge Mount Pin & Barrel Stainless Steel Continuous Hinge	700 Series	300 Series	650 Series	300 Series

- B. Continuous hinges shall be full height pin and barrel type hinge providing full height door support up to 600 lbs. Edge mount (unless noted otherwise).
- C. Construct hinges of heavy-duty 14-gauge material. The stainless internal pin shall have a diameter of 0.25 and the exterior barrel diameter of 0.438.
- D. Hinge shall be non-handed with symmetrical template hole pattern and factory drilled. Hinge must accept a minimum of 21 fasteners on the door and 21 fasteners on the frame.
- E. Each knuckle to be 2 inch, including split nylon bearing at each separation for quiet, smooth, self-lubricating operation.
- F. Hinge to be able to carry Warnock Hersey Int. or UL for fire rated doors and frames up to 3 hours.
- G. Provide machine screws for doors which have been reinforced to accept machine screws.
- H. Note: Fire label for doors and frames should be placed on the header and top rail of fire rated doors and frames.

## 2.05 POWER TRANSFERS

- A. Acceptable manufacturers and respective catalog numbers:

	Von Duprin	ASSA
Concealed Two Wire	EPT-2	CEPT-10
Concealed Ten Wire	EPT-10	CEPT-10

- B. Concealed power transfers shall be concealed in the door and frame when the door is closed.
- C. Concealed power transfers shall have a steel tube to protect wires from being cut.
- D. Concealed power transfers with spring tubes shall be rejected.
- E. Concealed power transfers shall be supplied with a mud box to house all terminations.

## 2.06 LOCKS AND LATCHES

- A. Acceptable manufacturers and respective catalog numbers:

	Schlage	Sargent	Corbin	Best
Grade 1 Cylindrical	ND Series SPA	10 Line LP	CL3300 PZD	9K Series 14D
Grade 1 Mortise	L9000 Series 17A	8200 Series LNP	ML2000 Series PS	45H Series 14H

- B. Minimize transmission of heat to lock trim. Provide temperature control modules (TCM) on all electrified locks when cataloged by the lock manufacturer.



- C. Unless otherwise specified, all locks and latches to have:
  1. 2-3/4" Backset
  2. 1/2" minimum throw latchbolt
  3. 1" throw deadbolt
  4. 6 pin cylinders
  5. ANSI A115.2 strikes
- D. Provide guarded latch bolts for all locksets, and latch bolts with sufficient throw to maintain fire rating of both single and paired door assemblies.
- E. Length of strike lip shall be sufficient to clear surrounding trim.
- F. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.

**2.07 MAGNETIC LOCKS**

- A. Acceptable manufacturers and respective catalog numbers:

	Schlage Electronics	Securitron
Direct Hold	M490 Series	82B

- B. Provide magnetic locks as specified, complete with mounting brackets and fasteners appropriate to the application. Direct Hold magnetic locks shall have a minimum of 1500 lbs holding force.
- C. Provide magnetic locks with integral magnetic bond sensor, time delay (1-90 Seconds) for re-locking, and LED status indicator as noted in hardware groups.
- D. Provide regulated and filtered power supplies for magnetic locks by the same manufacturer.

**2.08 DOOR POSITION SWITCHES**

- A. Acceptable manufacturers and respective catalog numbers:

	Schlage Electronics	Sentrol	Sargent
Concealed (wood and hollow metal doors)	679 Series	1076W	3287

**2.09 ELECTRIC STRIKES**

- A. Acceptable manufacturers and respective catalog numbers:

	Von Duprin	Folger Adams
Type 1	6000 Series	300 Series

- B. Provide electric strikes designed for use with the type of locks shown at each opening where specified.
- C. Electric strikes shall be UL listed as Burglary-Resistant Electric Door Strikes and where required shall be UL listed as Electric Strike for Fire Doors.

D. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

## 2.10 POWER SUPPLIES

- A. Provide quantities and types as specified in hardware sets. Shared power supplies will not be accepted without prior approval from the owner.
- B. All power supplies shall have the following features:
1. 12/24 VDC Output, field selectable.
  2. Class 2 Rated power limited output.
  3. Universal 120-240 VAC input.
  4. Low voltage DC, regulated and filtered.
  5. Polarized connector for distribution boards.
  6. Fused primary input.
  7. AC input and DC output monitoring circuit w/LED indicators.
  8. Cover mounted AC Input indication.
  9. Tested and certified to meet UL294.
  10. NEMA 1 enclosure.
  11. Hinged cover w/lock down screws.
  12. High voltage protective cover.
- C. All power supplies shall incorporate fused distribution boards.
- D. All electro-mechanical systems requiring fail safe circuits shall be capable of interfacing with the fire alarm system to cut power to appropriate system components. Unless already provided in another system component, all power supplies utilized in fail safe circuits shall include an integral relay which when connected to the N/C fire alarm contact will cut power to all openings connected to the individual power supply. Power supply, unless otherwise specified, will automatically reset itself when fire alarm relay returns to normal state following a fire alarm.

## 2.11 FLUSH BOLTS AND DUST PROOF STRIKES

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Door Controls	Hager	Rockwood
Dust Proof Strike	DP2	80	280X	570
Auto Flush Bolt (Metal Door)	FB31P	842	292D	2842
Auto Flush Bolt (Wood Door)	FB41P	942	291D	2942
Manual Flush Bolt	FB458	780	282D	555

- B. Unless otherwise specified, provide 12" rods for manual flush bolts for door 7'6" or less, 24" top rods for doors over 7'6" to 8'6".
- C. Unless otherwise specified, provide doors over 8'6" with automatic top bolts.
- D. Provide automatic flush bolts where required to maintain fire door listing and or egress requirements on pairs of doors.
- E. All flush-bolt applications shall be UL listed to be installed with top flush-bolt only. Provide auxiliary fire bolt as required for fire rated openings where less bottom bolt has been specified.

- F. Provide all bottom flush bolts with non-locking dust proof strikes.

**2.12 EXIT DEVICES**

- A. Acceptable manufacturers and respective catalog numbers:

	Von Duprin	Sargent	Detex
Wide Stile, Push Pad	98/99 Series	GL-43-80 Series	Advantex (Wide Stile)
Wide Stile, Electric Latch Retraction	QEL 98/99 Series	GL-43-56-80 Series	Advantex-ER (Wide Stile)
Lever Trim	996 Series	740 ET	"D/DM" Trim
Pull Trim	990 Series	800 MAL	"C" Trim

- B. Obtain exit devices from a single manufacturer, although several may be indicated as offering products complying with requirements.
- C. All exit devices shall be equipped with a sound-dampening feature to reduce touch pad return noise.
- D. Quiet Electric Latch Retraction shall be accomplished using a motor driven assembly, and shall incorporate the following features:
  1. Motor shall retract both the push pad assembly and latchbolt.
  2. Automatic calibration of latch throw and pull.
  3. Built-in time delay.
  4. On-board installation and troubleshooting diagnostics built into power supply and device.
  5. Retry mode if device does not pull on the first try.
- E. All exit devices shall be provided with flush end caps to reduce potential damage from impact.
- F. All exit devices shall be provided with dead-locking latch bolts to insure security.
- G. All exit devices shall be U.L. listed for accident hazard. Exit device for use on fire doors shall also be U.L. listed for fire exit hardware.
- H. Provide optional strikes, special length rods, and adapter plates to accommodate door and frame conditions. Provide narrow style series devices in lieu of wide stile series devices where optional strikes will not accommodate door and frame conditions.
- I. Coordinate with related trades to insure adequate clearance and reinforcement is provided in doors and frames. Provide thru bolts as required.
- J. Refer to hardware groups for exit device applications utilizing the option of: "less bottom rod and floor strike" (LBR)
- K. All exit devices shall be provided with optional trim designs to match other lever and pull designs used on the project.
- L. Unless specific exit device dogging options are noted within hardware sets, provide dogging options as follows:
  1. Fire Rated devices: Dogging not permitted.
  2. Non-Rated Exit Only functions not equipped with outside trim or pull: Less Dogging.
  3. Non-Rated Classroom functions: Less Dogging.

- 4. Non-Rated devices utilizing electric latch retraction or electrified outside trim: Less Dogging.
- 5. All Other Non-Rated devices: Cylinder Dogging utilizing interchangeable core cylinders. Cylinder keyway shall match locksets furnished on this project.
- M. Provide glass bead kits as required to accommodate door conditions. Screws shall not be visible through full glass doors.
- N. Where specified, provide compatible keyed mullions with cylinder for pairs of doors.
- O. Provide reinforced crossbars for all traditional style exit devices applied to doors over 36" wide.

**2.13 CLOSERS**

- A. Acceptable manufacturers and respective catalog numbers:

LCN	Norton	Sargent	Corbin
4050/4050 EDA	R7500/PR7500	351/351P10	DC8000 A10/DC8000 A3

- B. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.
- C. Provide extra heavy duty arm (EDA / HD) when closer is to be installed using parallel arm mounting.
- D. Hardware supplier shall coordinate with related trades to insure aluminum frame profiles will accommodate specified door closers.
- E. Closers shall use high strength cast cylinders, forged main arms, and 1 piece forged steel pistons.
- F. Closers shall utilize a stable fluid withstanding temperature range of +120 deg F to -30 deg F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.
- G. Unless otherwise specified, all door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.
- H. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.
- I. Provide closers with adjustable spring power. Size closers to insure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.
- J. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.
- K. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.
- L. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100 hour salt spray test.
- M. Pressure Relief Valve, PRV, shall not be acceptable.

**2.14 LOW ENERGY ELECTRO-HYDRAULIC AUTOMATIC OPERATORS**

A. Acceptable manufacturers and respective catalog numbers:

	LCN	Besam
Electro-Hydraulic Operator	4640	PowerSwing

B. Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA for opening force and time to close standards.

C. The closing action shall be controlled by modern type cast iron door closer cylinder filled with a flat viscosity fluid, stable from +120F to -30F that would require no seasonal adjustments. The closer shall have field adjustable spring power; have two independent closing speed adjustment valves, and hydraulic back-check.

D. Full closing force shall be provided when the power or assist cycle ends.

E. All power operator systems shall include the following features and functions:

1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
2. The operator will be designed with an electronically controlled mechanical clutching mechanism to prevent damage to the operator if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
4. UL listed for use on labeled doors.
5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.
6. The power operator shall incorporate microprocessor controlled digital controls including: factory default memory settings, on-board diagnostics, non-volital memory, and integrated delay and relay for controlling door release devices.
7. Provisions in the control box or module shall provide control inputs and outputs) for; electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, and stop side sensors.
8. Wall mounted actuators shall consist of a 4-1/2 inch diameter stainless steel touch plate with a blue filled handicapped symbol. Switches shall be weather resistant and mount on a single gang electrical box furnished by Division 26.

F. All electrically powered operators shall include the following features or functions:

1. When an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
2. Easily accessible main power and maintain hold open switches will be provided on the operator.
3. An electronically controlled clutch to provide adjustable opening force.
4. A microprocessor to control all motor and clutch functions.
5. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.
6. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.
7. If electrical failure occurs, the unit shall operate as a standard door closer.

- G. Power Operators shall be warranted by the manufacture to be free from defects in material and workmanship for a period of two years.

**2.15 OVERHEAD STOPS**

- A. Acceptable manufacturers and respective catalog numbers:

	Glynn-Johnson	Rixson	Sargent
Heavy Duty Surface Mount	GJ900 Series	9 Series	590
Heavy Duty Concealed Mount	GJ100 Series	1 Series	690

- B. Overhead stops (including slide block and end caps) shall be fabricated from metal.
- C. Unless otherwise specified, furnish GJ900 series overhead stop for doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.
- D. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.
- E. Provide special stop only (“SE” suffix) overhead stops when used in conjunction with electronic hold open closers.
- F. Do not provide holder function for labeled doors.

**2.16 WALL STOPS AND HOLDERS**

- A. Acceptable manufacturers and respective catalog numbers:

	Ives	Hager	Burns	Rockwood
Wrought Convex Wall Bumper	WS406CVX	232W	570	406
Wrought Concave Wall Bumper	WS406CCV	236W	575	409
Automatic Wall Holder	WS40	326W	533	490

- B. Furnish a stop or holder for all doors. Furnish floor stops or hinge pin stops only where specifically specified.
- C. Where wall stops are not applicable, furnish overhead stops.
- D. Do not provide holder function for labeled doors.

**2.17 MAGNETIC HOLD OPENS**

- A. Acceptable manufacturers and respective catalog numbers:

	LCN	ABH	Edwards
Wall Holder	SEM 7800	2000	1500

- B. Magnetic holder's housing and armature shall be constructed of a die cast zinc material.
- C. Provide types as listed in groups.
- D. Where wall conditions do not permit the armature to reach the magnet, provide extensions.
- E. Provide proper voltage and power consumption as required by Division 26.
- F. Coordinate electrical requirements and mounting locations with other trades.

**2.18 WEATHERSTRIP, GASKETING**

- A. Acceptable manufacturers and respective catalog numbers:

	Zero	Pemko	NGP	Reese
Weatherstrip	429	2891_PK	700NA	755
Adhesive Gasket	188S	S88	5050	797
Mullion Seal/Silencer	8780	5110	5100N	
Meeting Edge Seals	8193	18041	9605	959
Automatic Door Bottom (hard surface)	360	434_RL	423N	430
Automatic Door Bottom (carpet)	360	434_NBL	683	943
Automatic Door Bottom	355	420APKL	320N	372A
Sweeps	8192	18061_NB	B606	964
Sweep w/ Drip	8198	345_N	C627	354
Drip Cap	142	346	16	R201

- B. Where specified in the hardware groups, furnish the above products unless otherwise detailed in groups.
- C. Provide weatherstripping all exterior doors and where specified.
- D. Provide intumescent and other required edge sealing systems as required by individual fire door listings to comply with positive pressure standards UL 10C.
- E. Provide Zero 188S smoke gaskets at all fire rated doors and smoke and draft control assemblies.
- F. Provide gasketing for all meeting edges on pairs of fire doors. Gasketing shall be compatible with astragal design provided by door supplier as required for specific fire door listings.

**2.19 THRESHOLDS**

- A. Acceptable manufacturers and respective catalog numbers:

	Zero	Pemko	NGP	Reese
Saddle Thresholds	8655	171	425	S205

- B. Hardware supplier shall verify all finish floor conditions and coordinate proper threshold as required to insure a smooth transition between threshold and interior floor finish.

C. Threshold Types:

1. Unless otherwise specified, provide saddle threshold similar to Zero 8655 for all exterior openings with an interior floor finish less than or equal to 1/4" in height.
2. Unless otherwise specified, provide half saddle threshold similar to Zero 1674 for all exterior openings with an interior floor finish greater than 1/4" in height. Threshold height shall match thickness of interior floor finish.

**2.20 PULLS, PUSH BARS, PUSH/PULL PLATES**

A. Acceptable manufacturers and respective catalog numbers:

	Burns	Hager	Rockwood	Ives
Straight Pull (1" dia. 10" ctc)	26C	4J	111	8103-0
Straight Pull (3/4" dia. 8" ctc)	25B	3G	107	8102-8
Offset Door Pull (1" dia. 10" ctc)	39C	12J	BF157	8190-0
Pull/Push Bar (1" dia. 10" ctc Pull)	422 x 26C	153	11147	9103-0
Offset Pull/Push Bar (1" dia. 10" ctc Pull)	422 x 39C	157	BF15747	9190-0
Push Plate (0.050 4" x 16")	54	30S 4 x 16	70C	8200 4" x 16"
Push Plate (0.050 6" x 16")	56	30S 6 x 16	70E	8200 6" x 16"
Pull Plate (1" dia. 10" ctc - 0.050" x 4" x 16")	5426C	34J 4 x 16	111 x 70C	8303-0 4" x 16"

- B. Adjust dimensions of push plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, push plates shall be factory drilled for cylinders or other mortised hardware. All push plates shall be beveled 4 sides and counter sunk.
- C. Where possible, provide back-to-back, and concealed mounting for pulls and push bars. Push bar length shall be 3" less door width, or center of stile to center of stile for stile & rail or full glass doors.

**2.21 COORDINATORS**

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Door Controls	Hager	Rockwood
Bar Coordinator	COR x FL	600 x Filler	297D x 297F	2600 Series
Mounting Bracket	MB Series	AB, C Series	297 Series	2600 Series

- B. Provide coordinators at all pairs of doors having automatic flush bolts and closers on the inactive leaf, and for pairs of doors having vertical rod/mortise exit device combinations with overlapping astragals.
- C. Provide appropriate filler bars, closer mounting brackets, carry bars, and special top latch preparations as required by adjacent hardware.

**2.22 KICK PLATES AND MOP PLATES**

A. Acceptable manufacturers and respective catalog numbers:

	Rockwood	Hager	Ives	Hiawatha
Kick Plate	K1050	190S	8400	J102



- B. Furnish protective plates as specified in hardware groups.
- C. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.
- D. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing.
- E. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.
- F. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

**2.23 SLIDING DOOR HARDWARE**

- A. Acceptable Manufacturers and respective catalog numbers:

	KN Crowder
Face Mounted Track	C412
Fascia	C413
Hangers	C411
Door Guides	C913
Door Guide Channel	C914
Angle Stop	C100

- B. Provide complete hardware sets for each opening specified with sliding door hardware. Include track, ball-bearing hangers, door stops, fasteners, guides, and all hardware required for a complete installation.
- C. Hardware supplier shall coordinate with related trades to insure that wall pocket framing will accommodate specified hardware.

**2.24 KEYING**

- A. Acceptable manufacturers and respective catalog numbers:

Schlage	Sargent	Corbin
Everest 29	Degree	Access

- B. Provide all locks and cylinders utilizing a patented keyway to prevent manufacturing and distribution of aftermarket key blanks by anyone other than factory authorized dealers.
- C. All locks under this section shall be keyed as directed by the owner to a new Patented Grand Master Key System.
- D. Keying shall be by lock manufacturer where permanent records shall be kept.

- E. Furnish a total of 2 keys per cylinder. Actual cut keys to be determined by owner.
- F. Master keys and control keys to be delivered by registered mail to the owner. Change keys shall be delivered in a set up key cabinet. Construction keys shall be delivered to the contractor.

**2.25 KEY CABINETS**

- A. Acceptable manufacturers and respective catalog numbers:

Lund	Key Control	Telkee
1200-1205 AA	M228-2480	RWC-AWC

- B. Furnish 1 each model 1200 or 1205 AA key cabinet with a capacity 1.5 times the number of key sets.
- C. Provide one key cabinet with at least one hook for each key set, plus additional hooks for 50% expansion.
- D. Furnish key cabinet complete with cam lock, permanent key tags, and change key cards.
- E. Hardware supplier shall prepare all key change index records, tag all keys and place permanent file keys in cabinet.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of the correct characteristics.
- C. Prior to installation of hardware, installer shall examine door frame installation to insure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely effect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

**3.02 INSTALLATION**

- A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.
- B. Install all hardware in accordance with the approved hardware schedule and manufacturers instructions for installation and adjustment.
- C. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

- D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.
- E. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.
- F. Shim doors as required to maintain proper operating clearance between door and frame.
- G. Unless otherwise specified, locate all hardware in accordance with the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute.
- H. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.
- I. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- J. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.
- K. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the label.
- L. Apply self-adhesive gasketing on frame stop at head & latch side and on rabbet of frame at hinge side.
- M. Install hardware in accordance with supplemental "S" label instructions on all fire rated openings.
- N. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.
- O. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.
- P. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.
- Q. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.
- R. Adjust spring power of door closers to the minimum force required to insure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to insure opening force does not to exceed 5 lbs.
- S. Adjust "sweep", "latch", & "back check" valves on all door closers to properly control door through out the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.
- T. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.
- U. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.
- V. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water resistant seal.

- W. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

### **3.03 CLEANING**

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

### **3.04 PROTECTION**

- A. Protect finished Work under provisions of Section 01 7000 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

### **3.05 HARDWARE SETS**

- A. GROUP 4.2
  - 1. Hinges as specified
  - 2. 1 Storeroom lockset
  - 3. 1 Manual flushbolt (top only)
  - 4. 2 Wall stops
  - 5. 2 Kickplates
- B. GROUP 11.0
  - 1. Hinges as specified
  - 2. 1 Passage lockset
  - 3. 1 Closer
  - 4. 1 Kickplate
  - 5. 1 Wall stop
- C. GROUP 11.1
  - 1. Hinges as specified
  - 2. 1 Passage lockset
  - 3. 1 Closer
  - 4. 1 Kickplate
  - 5. 1 Wall stop
  - 6. 1 set Fire seals
- D. GROUP 12.0
  - 1. Hinges as specified
  - 2. 1 Privacy lockset
  - 3. 1 Closer
  - 4. 1 Kickplate
  - 5. 1 Wall stop
  - 6. 1 set Fire seals
- E. GROUP 13.1
  - 1. Hinges as specified
  - 2. 1 Classroom lockset
  - 3. 1 Closer
  - 4. 1 Kickplate

5. 1 Magnetic hold open
  6. 1 set Fire seals
- F. GROUP 13.2
1. Hinges as specified
  2. 1 Classroom lockset
  3. 1 Closer
  4. 1 Kickplate
  5. 1 Wall stop
  6. 1 set Fire seals
- G. GROUP 14.0
1. Hinges as specified
  2. 1 Storeroom lockset
  3. 1 Closer
  4. 1 Kickplate
  5. 1 Wall stop
- H. GROUP 14.1
1. Hinges as specified
  2. 1 Storeroom lockset
  3. 1 Closer
  4. 1 Kickplate
  5. 1 Wall stop
  6. 1 set Fire seals
- I. GROUP 21.0
1. Hinges as specified
  2. 1 Passage lockset
  3. 1 Automatic flushbolts
  4. 2 Closer
  5. 2 Magnetic hold open
  6. 2 Kickplate
  7. 1 Coordinator
  8. 1 set Fire seals
- J. GROUP 31.0
1. Hinges as specified
  2. 1 Panic device; passage function, fire rated
  3. 1 Closer
  4. 1 Kickplate
  5. 1 Wall stop
  6. 1 set Fire seals
- K. GROUP 34.0
1. Hinges as specified
  2. 1 Panic device; storeroom function, fire rated
  3. 1 Closer
  4. 1 Kickplate
  5. 1 Wall stop
  6. 1 set Fire seals

- L. GROUP 91.0
  - 1. Hinges by door manufacturer
  - 2. 1 Door saver
  - 3. 1 Passage lockset
  
- M. GROUP 91.1
  - 1. Hinges by door manufacturer
  - 2. 1 Roller stop in head (per leaf)
  - 3. 1 Dummy pull (per leaf)
  - 4. 1 Door saver (per leaf)
  
- N. GROUP 92.0
  - 1. Hinges by door manufacturer
  - 2. 1 Door saver
  - 3. 1 Privacy lockset
  
- O. GROUP 93.0
  - 1. 1 Standard hinge
  - 2. 2 Spring hinges
  - 3. 1 Door saver
  - 4. 1 Passage lockset
  - 5. 1 Deadbolt
  - 6. 1 Door chain
  - 7. 1 Door viewer (Provide 2 at Type A Units)
  - 8. 1 Set fire seals
  - 9. 1 Threshold
  - 10. 1 Door sweep
  
- P. GROUP 97.0
  - 1. Interior lock and sliding door hardware by manufacturer
  
- Q. GROUP 254.0
  - 1. 1 Continuous hinge
  - 2. 1 Panic device; storeroom function, less dogging
  - 3. 1 Electric strike
  - 4. 1 Low energy operator
  - 5. 2 Wall mounted actuators
  - 6. 1 Overhead stop
  - 7. 1 Telephone entry system by Electrical Contractor
  
- R. GROUP 314.0
  - 1. 1 Continuous hinge
  - 2. 1 Storeroom lockset
  - 3. 1 Electric strike
  - 4. 1 Low energy operator
  - 5. 2 Wall mounted actuators
  - 6. 1 Overhead stop
  - 7. 1 set Weatherstrip
  - 8. 1 Threshold
  - 9. 1 Rain drip
  - 10. 1 Door sweep with drip

- S. GROUP 324.0
  - 1. 2 Continuous hinge
  - 2. 1 Storeroom lockset
  - 3. 2 Manual flushbolts (top and bottom)
  - 4. 1 Astragal
  - 5. 1 Closer
  - 6. 2 Overhead stop with hold open
  - 7. 2 Wall mounted actuators
  - 8. 1 Overhead stop
  - 9. 1 set Weatherstrip
  - 10. 1 Threshold
  - 11. 1 Rain drip
  - 12. 2 Door sweep with drip
  
- T. GROUP 334.0
  - 1. 1 Continuous hinge
  - 2. 1 Panic device; storeroom function, cylinder dogging
  - 3. 1 Closer with hold open function
  - 4. 1 Overhead stop
  - 5. 1 set Weatherstrip
  - 6. 1 Threshold
  - 7. 1 Rain drip
  - 8. 1 Door sweep with drip
  
- U. GROUP 351.0
  - 1. 1 Continuous hinge
  - 2. 1 Panic device; passage function
  - 3. 1 Electric strike
  - 4. 1 Low energy operator
  - 5. 2 Wall mounted actuators
  - 6. 1 Overhead stop
  - 7. 1 set Weatherstrip
  - 8. 1 Threshold
  - 9. 1 Rain drip
  - 10. 1 Door sweep with drip

**END OF SECTION**





## **SECTION 08 8000 - GLAZING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds and accessories.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 2500 - Weather Barriers.

#### **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; 2010.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- D. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- G. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
- H. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- I. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- J. GANA (GM) - GANA Glazing Manual; 2009.
- K. GANA (SM) - GANA Sealant Manual; 2008.
- L. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.
- M. ICC (IBC) - International Building Code; 2015.
- N. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).
- O. ITS (DIR) - Directory of Listed Products; current edition.
- P. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- Q. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2012.

- R. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2014.
- S. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014.
- T. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2014.
- U. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- V. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.
- W. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit 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. Identify available colors.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

#### **1.06 FIELD CONDITIONS**

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### **1.07 WARRANTY**

- A. See Section 01 7800 - 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 replacement of failed units.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Float Glass Manufacturers:
  - 1. Cardinal Glass Industries: [www.cardinalcorp.com](http://www.cardinalcorp.com).
  - 2. Guardian Industries Corp: [www.sunguardglass.com](http://www.sunguardglass.com).
  - 3. Pilkington North America Inc: [www.pilkington.com/na](http://www.pilkington.com/na).
  - 4. PPG Industries, Inc: [www.ppgideascales.com](http://www.ppgideascales.com).
  - 5. Substitutions: Refer to Section 01 6000 - 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 applicable codes.
  - 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. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
  - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
    - a. Refer to Section 07 2500.
  - 2. To utilize the inner pane of multiple pane insulating glass units for the continuity of the vapor retarder and air barrier seal.
  - 3. To maintain a continuous vapor retarder and air barrier throughout the glazed assembly from glass pane to heel bead of glazing sealant.
- C. Thermal and Optical Performance: Provide glass 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 noted otherwise.
  - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
  - 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
  - 3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 criteria.
  - 4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality-Q3, color and performance characteristics as indicated.
  - 5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

## 2.04 INSULATING GLASS UNITS

- A. Manufacturers:
  - 1. Cardinal Glass Industries: [www.cardinalcorp.com](http://www.cardinalcorp.com).
  - 2. Guardian Industries Corp: [www.sunguardglass.com](http://www.sunguardglass.com).
  - 3. Pilkington North America Inc: [www.pilkington.com/na](http://www.pilkington.com/na).
  - 4. PPG Industries, Inc: [www.ppgideascales.com](http://www.ppgideascales.com).
  - 5. Viracon, Apogee Enterprises, Inc: [www.viracon.com](http://www.viracon.com).
  - 6. Substitutions: Refer to Section 01 6000 - Product Requirements.
  
- B. Insulating Glass Units: Types as indicated.
  - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
  - 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
  - 3. Metal Edge Spacers: Aluminum, bent and soldered corners.
  - 4. Spacer Color: Black.
  - 5. Edge Seal:
    - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
  - 6. Color: Black.
  - 7. Purge interpane space with dry air, hermetically sealed.
  
- C. Insulating Glass Units <INSUL GL-1>: Vision glass, double glazed.
  - 1. Applications: Exterior glazing unless otherwise indicated.
  - 2. Space between lites filled with argon.
  - 3. Outboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum.
    - a. Tint: Clear.
    - b. Coating: Low-E (passive type), on #2 surface.
      - 1) Basis of Design:
        - (a) VNE1-63 by Viracon.
        - (b) PPG Industries: Solarban 70XL.
        - (c) Guardian Industries: SunGuard SNX 62/27.
  - 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick, minimum.
    - a. Tint: Clear.
  - 5. Total Thickness: 1 inch (25.4 mm).
  - 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.25, nominal.
  - 7. Visible Light Transmittance (VLT): 62 percent, nominal.
  - 8. Solar Heat Gain Coefficient (SHGC): 28 percent, nominal.
  - 9. Visible Light Reflectance, Outside: 10 percent, nominal.
  
- D. Insulating Glass Units: Safety glazing.
  - 1. Applications:
    - a. Glazed lites in exterior doors.
    - b. Glazed sidelights and panels next to doors.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
    - d. Other locations where the material ID includes <INSUL TEMP\_\_\_\_>.
  - 2. Space between lites filled with argon.
  - 3. Glass Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.

4. Total Thickness: 1 inch (25.4 mm).

## 2.05 GLAZING UNITS

- A. Monolithic Interior Vision Glazing <GL-1>:
  1. Applications: Interior glazing unless otherwise indicated.
  2. Glass Type: Heat-strengthened float glass.
  3. Tint: Clear.
  4. Thickness: 1/4 inch (6.4 mm), nominal.
  
- B. Fire-Protection-Rated Glazing <FR GL-DH45>, <FR GL-OH45>: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period of 45 minutes or less.
  1. Applications:
    - a. Glazing in fire-rated door assembly.
    - b. Glazing in fire-rated window assembly.
    - c. Other locations as indicated on drawings.
  2. Laminated Glass (Type G3) <FR LAM GL-1>
    - a. Provide at fire-rated locations as required by code.
    - b. Provide Pilkington Pyrodur in locations requiring maximum 20 minute fire rating.
    - c. Provide "FireLite NT" in locations requiring 45 or 90 minute fire rating.
    - d. Provide "Pilkinton Pyrostop" in locations with greater than 25% of glazed wall area.
  3. Glass Type: Safety ceramic glass.
  4. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
  5. Safety Glazing Certification: 16 CFR 1201 Category II.
  6. Glazing Method: As required for fire rating.
  7. Fire-Rating Period: As indicated on drawings.
  8. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction
    - a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
    - b. "OH" - meets fire window assembly criteria including hose stream test of NFPA 257, or UL 9 fire test standards.
    - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
    - d. "XXX" - placeholder that represents fire-rating period, in minutes.
  9. Manufacturers:
    - a. SAFTIFIRST, a division of O'Keeffe's Inc: [www.safti.com/sle](http://www.safti.com/sle).
    - b. Technical Glass Products: [www.fireglass.com](http://www.fireglass.com).
    - c. Vetrotech Saint-Gobain North America: [www.vetrotechusa.com](http://www.vetrotechusa.com).
    - d. Substitutions: Refer to Section 01 6000 - Product Requirements.
  
- C. Monolithic Safety Glazing: Non-fire-rated.
  1. Applications:
    - a. Glazed lites in doors, except fire doors.
    - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
    - d. Other locations indicated on drawings.
    - e. Other locations where the material ID includes <TEMP GL-\_\_\_\_>.
  2. <TEMP GL-\_\_\_\_> Glass Type: Fully tempered safety glass as specified.
  3. Tint: Clear.
  4. Thickness: 1/4 inch (6.4 mm), nominal.

## **2.06 GLAZING COMPOUNDS**

- A. Manufacturers:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Dow Corning Corporation: [www.dowcorning.com/construction](http://www.dowcorning.com/construction).
  - 3. Momentive Performance Materials, Inc: [www.momentive.com](http://www.momentive.com).
  - 4. Pecora Corporation: [www.pecora.com](http://www.pecora.com).
  - 5. BASF Corporation: [www.basf.com/us/en.html](http://www.basf.com/us/en.html).
  - 6. Substitutions: Refer to Section 01 6000 - Product Requirements.

## **2.07 ACCESSORIES**

- A. Setting Blocks: Neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) x width of glazing rabbet space minus 1/16 inch (1.5 mm) x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch (75 mm) long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

## **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 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.
- C. Verify that sealing between joints of glass framing members has been completed effectively.
- D. 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, etc.

#### **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 (152 mm) 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 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent 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.

#### **3.06 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.

### **END OF SECTION**





# **SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Acoustic insulation.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.

### **1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.
- B. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

### **1.03 REFERENCE STANDARDS**

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board; 2004 (Reapproved 2014).
- C. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- G. 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; 2014.
- H. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- I. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.
- J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- K. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.

- L. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- M. ASTM E413 - Classification for Rating Sound Insulation; 2010.
- N. GA-216 - Application and Finishing of Gypsum Board; 2013.
- O. GA-600 - Fire Resistance Design Manual; 2015.
- P. UL (FRD) - Fire Resistance Directory; current edition.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on gypsum board.
- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

## **PART 2 PRODUCTS**

### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
  1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
  2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
  1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

### **2.02 METAL FRAMING MATERIALS**

- A. Resilient Furring Channels <MET FURG-4>: 1/2 inch (12 mm) depth, for attachment to substrate through one leg only.
- B. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
  1. C-H Studs <MET STUD-5>: Gauge as required by UL listing.

### **2.03 BOARD MATERIALS**

- A. Manufacturers - Gypsum-Based Board:
  1. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  2. Georgia-Pacific Gypsum: [www.gpgypsum.com](http://www.gpgypsum.com).
  3. National Gypsum Company: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  4. USG Corporation: [www.usg.com](http://www.usg.com).
  5. Substitutions: See Section 01 6000 - Product Requirements.

- B. Gypsum Board Source Limitation: No gypsum board produced outside of the United States may be used in this construction project.
- C. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Material ID:
    - a. <GYP BD-1>: 5/8 inch Type X.
    - b. <GYP BD-4>: 5/8 inch Type C.
  2. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, Type C, UL or WH listed.
  4. Paper-Faced Products:
    - a. USG Corporation: Sheetrock Brand Gypsum Panels.
    - b. National Gypsum Company: Gold Bond Gypsum Panels.
    - c. CertainTeed Gypsum: ProRoc.
    - d. Georgia-Pacific Gypsum; ToughRock.
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- D. Backing Board For Wet Areas: One of the following products:
1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings where indicated as <GYP BD-1>.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
    - a. Standard Type: Thickness 1/2 inch (12.7 mm).
    - b. Products:
      - 1) Georgia-Pacific Gypsum; DensShield Tile Backer.
      - 2) National Gypsum Company; Gold Bond eXP Tile Backer.
      - 3) USG Corporation: Durock Brand Glass Mat Tile Backer Board.
      - 4) CertainTeed Gypsum: GlasRoc Tile Backer.
- E. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces in bathrooms with material ID <GYP BD-1>.
  2. Type X Thickness: 5/8 inch (16 mm).
  3. Edges: Tapered.
  4. Products:
    - a. Georgia-Pacific Gypsum; ToughRock Mold-Guard Gypsum Board.
    - b. National Gypsum Company; Gold Bond XP Gypsum Board.
    - c. USG Corporation: Sheetrock Brand Mold Tough.
    - d. CertainTeed Gypsum: Moisture and Mold Resistant.
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- F. Shaftwall and Coreboard <GYP BD-20>: Type X; 1 inch (25 mm) thick by 24 inches (610 mm) wide, beveled long edges, ends square cut.
1. Paper Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
  2. Products:
    - a. Georgia-Pacific Gypsum; ToughRock Shaftliner.
    - b. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP.
    - c. USG Corporation: Sheetrock Brand Shaftwall Liner.

- d. CertainTeed Gypsum: ProRoc Shaft Liner.
- e. Substitutions: See Section 01 6000 - Product Requirements.

## **2.04 ACCESSORIES**

- A. Acoustic Insulation <INSUL-80>: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 2 inch (51 mm).
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
  - 1. Types: As detailed or required for finished appearance.
- D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  - 1. Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners.
  - 2. Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners.
  - 3. Ready-mixed vinyl-based joint compound.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- F. Nails for Attachment to Wood Members: ASTM C514.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

### **3.02 SHAFT WALL INSTALLATION**

- A. Shaft Wall Framing: Install in accordance with GA-600 requirements.
  - 1. Fasten runners to structure with short leg to finished side, using appropriate power-driven fasteners at not more than 24 inches (600 mm) on center.
  - 2. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.
  - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
  - 2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

### **3.03 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Place continuous bead at perimeter of each layer of gypsum board.
  - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

### **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 Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
  - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For non-rated assemblies, install as follows:
  - 1. Single-Layer Applications: Screw attachment.
  - 2. Double-Layer Application: Install base layer using screws or nails. Install face layer using screws.

### **3.05 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

### **3.06 JOINT TREATMENT**

- A. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based 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 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  - 3. Level 1: 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 (0.8 mm).

### **3.07 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

## **END OF SECTION**



## **SECTION 09 3000 - TILING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

#### **1.03 REFERENCE STANDARDS**

- A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2013.1.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- K. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; 2010 (Revised).
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).

- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- N. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
- O. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- P. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2010 (Revised).
- Q. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- R. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2012.
- S. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2013.1.
- T. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2016.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

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

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Samples: Provide two tiles, actual size, illustrating pattern and color.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 6000 - Product Requirements, for additional provisions.
  2. Extra Tile: 10 square feet (1 square meters) of each size, color, and surface finish combination.

#### **1.06 QUALITY ASSURANCE**

- A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.



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

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

### **1.08 FIELD CONDITIONS**

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during installation of mortar materials.

### **1.09 WARRANTY**

- A. Tile and Stone Installation System Warranty: Manufacturer's standard system warranty protecting against break down or deterioration of the tile setting system under normal usage, and ensuring the products are free from manufacturer defects. Manufacturer shall pay for replacement of its own products and replacement of finishing materials, including labor, for defective portions of the project.
  - 1. Warranty Period: 25 years.

## **PART 2 PRODUCTS**

### **2.01 TILE**

- A. Manufacturers: All products by the same manufacturer.
- B. Ceramic Tile: ANSI A137.1, standard grade.
  - 1. Continental Slate manufactured by Daltile or approved equivalent product.
    - a. <CER TILE-10>: 12 by 12 inches, Indian Red.
    - b. <CER TILE-20>: 12 by 12 inches, Indian Red.
    - c. <CER TILE-21>: 12 by 12 inches, Moroccan Brown.

### **2.02 SETTING MATERIALS**

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4 or ANSI A118.15.
  - 1. Application(s): Use this type of bond coat where indicated below; basis of design product indicated.
    - a. Typical Floors:
      - 1) LATICRETE 254 Platinum.
      - 2) TEC Specialty Full Flex.
    - b. Typical Walls:
      - 1) LATICRETE 4-XLT.
      - 2) TEC Specialty Ultimate Large Tile.
  - 2. Products:
    - a. ARDEX Engineered Cements; ARDEX X 77 MICROTEC: [www.ardexamericas.com](http://www.ardexamericas.com).
    - b. LATICRETE International, Inc: [www.laticrete.com](http://www.laticrete.com).
    - c. ProSpec, an Oldcastle brand: [www.prospec.com](http://www.prospec.com).
    - d. Mapei Corporation: [www.mapei.com](http://www.mapei.com).
    - e. TEC Specialty: [www.tecspecialty.com](http://www.tecspecialty.com).
    - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.

## 2.03 GROUTS

- A. Manufacturers:
  - 1. LATICRETE International, Inc: [www.laticrete.com](http://www.laticrete.com).
  - 2. Mapei Corporation: [www.mapei.com](http://www.mapei.com).
  - 3. TEC Specialty: [www.tecspecialty.com](http://www.tecspecialty.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
  
- B. Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
  - 1. Applications: Use this type of grout for typical walls.
  - 2. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
  - 3. Basis of Design:
    - a. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: [www.laticrete.com](http://www.laticrete.com).
    - b. TEC Specialty; PowerGrout.
    - c. Substitutions: See Section 01 6000 - Product Requirements.
  
- C. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
  - 1. Applications: Floors.
  - 2. Color(s): As selected by Architect from manufacturer's full line.
  - 3. Basis of Design:
    - a. LATICRETE International, Inc; LATICRETE SpectraLOCK PRO Premium Grout.
    - b. TEC Specialty; Epoxy AccuColor EFX.
    - c. Substitutions: See Section 01 6000 - Product Requirements.

## 2.04 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
  - 1. Applications: Between tile and plumbing fixtures.
  - 2. Color(s): As selected by Architect from manufacturer's full line.
  - 3. Products:
    - a. LATICRETE International, Inc; LATICRETE LATASIL: [www.laticrete.com](http://www.laticrete.com).
    - b. TEC Specialty; Silicone Caulk.
    - c. Substitutions: See Section 01 6000 - Product Requirements.

## 2.05 ACCESSORY MATERIALS

- A. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
  - 1. Application: Provide at walls and ceilings in showers only. Provide at all floors.
  - 2. Fluid or Trowel Applied Type:
    - a. Products:
      - 1) LATICRETE International, Inc; LATICRETE HYDRO BAN: [www.laticrete.com](http://www.laticrete.com).
      - 2) TEC Specialty; HydraFlex.
      - 3) Substitutions: See Section 01 6000 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

### **3.03 INSTALLATION - GENERAL**

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1a thru A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Sound tile after setting. Replace hollow sounding units.
- G. Keep control and expansion joints free of mortar, grout, and adhesive.
- H. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- I. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.

- J. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

#### **3.04 INSTALLATION - FLOORS - THIN-SET METHODS**

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F115, with epoxy grout. Provide waterproofing membrane under all tile.
  - 1. Use uncoupling membrane under all tile unless other underlayment is indicated.

#### **3.05 INSTALLATION - SHOWERS AND BATHTUB WALLS**

- A. At walls install in accordance with TCNA (HB) Method B412, over cementitious backer units with waterproofing membrane.
- B. Grout with polymer modified grout.

#### **3.06 INSTALLATION - WALL TILE**

- A. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

#### **3.07 CLEANING**

- A. Clean tile and grout surfaces.

#### **3.08 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

### **END OF SECTION**

## **SECTION 09 5100 - SUSPENDED ACOUSTICAL CEILINGS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

#### **1.02 RELATED REQUIREMENTS**

- A. Divisions 21 through 28 for mechanical and electrical components in acoustical ceilings.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 4 x 6 inch (100 x 150 mm) 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 6000 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

#### **1.06 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.

### **1.07 FIELD CONDITIONS**

- A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Acoustic Tiles/Panels:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 3. USG: [www.usg.com](http://www.usg.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
  
- B. Suspension Systems:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).  
Rockfon, LLC: [www.rockfon.com](http://www.rockfon.com).
  - 3. USG: [www.usg.com](http://www.usg.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 ACOUSTICAL UNITS**

- A. Acoustical Panels <ACT-1>: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
  - 1. Size: 24 by 24 inches (600 by 600 mm).
  - 2. Thickness: 3/4 inches (19 mm).
  - 3. NRC Range: 0.65 to 0.75, determined in accordance with ASTM E1264.
  - 4. Edge: Reveal edge.
  - 5. Surface Color: White.
  - 6. Suspension System: Exposed grid.
  - 7. Basis of Design Product: Mars ClimaPlus by USG.

### **2.03 SUSPENSION SYSTEM(S)**

- A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
  
- B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; intermediate-duty.
  - 1. Profile: Tee; 15/16 inch (24 mm) wide face.
  - 2. Finish: White painted.

### **2.04 ACCESSORIES**

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
  
- B. Perimeter Moldings: Same material and finish as grid.

1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

## **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 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. 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.
- F. 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.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches (150 mm) of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  1. Use longest practical lengths.
  2. Miter corners.

### **3.03 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 units after above-ceiling work is complete.

- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
  - 1. Make field cut edges of same profile as factory edges.
  - 2. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Install hold-down clips on panels within 20 ft (6 m) of an exterior door.

#### **3.04 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

#### **END OF SECTION**



## **SECTION 09 6500 - RESILIENT FLOORING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Resilient stair accessories.
- E. Installation accessories.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- B. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014).
- C. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2014).
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- E. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).
- F. ASTM F2195 - Standard Specification for Linoleum Floor Tile; 2013.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Flooring Material: 100 square feet (9.29 square meters) of each type and color.
3. Extra Wall Base: 20 linear feet (6.1 linear meters) of each type and color.
4. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

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

- A. Protect roll materials from damage by storing on end.

#### **1.06 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 (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

#### **1.07 WARRANTY**

- A. Manufacturer's standard limited 5 year commercial warranty.

### **PART 2 PRODUCTS**

#### **2.01 SHEET FLOORING**

- A. Vinyl Sheet Flooring <VNL SHT-1>:
  1. Basis of Design: Mannington Benchmark.
  2. Minimum Requirements: Comply with ASTM F1913.
  3. Thickness: 0.080 inch (2.0 mm) nominal.
  4. Color: Kingsbridge.

#### **2.02 TILE FLOORING**

- A. Vinyl Composition Tile <VCT-1>: Homogeneous, with color extending throughout thickness, and:
  1. Basis of Design: Armstrong Standard Excellon.
  2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
  3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
  4. Size: 12 by 12 inch (305 by 305 mm).
  5. Thickness: 0.125 inch (3.2 mm).
  6. Color: Coaster Greige.
- B. Resilient Plank <RES PLNK-#>: Homogeneous wear layer bonded to backing, with color and pattern through wear layer thickness.
  1. Basis of Design: Mannington Andura.
  2. Minimum Requirements: Comply with ASTM 1700, Class 3 Type B.
  3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
  4. Backing: Synthetic fabric.
  5. Wear Layer Thickness: 0.020 inch (0.51 mm), minimum, excluding backing.
  6. Plank Size: 6 x 36 inches nominal (152 by 914 mm).
  7. Color:
    - a. <RES PLNK-1>: Burma Teak Butternut.
    - b. <RES PLNK-2>: Burma Teak Butternut.

### 2.03 STAIR COVERING

- A. Stair Nosings: 3-3/16 inch (81 mm) horizontal return, 1-7/16 inch (36 mm) vertical return, full width of stair tread in one piece.
  - 1. Basis of Design: Johnsonite VIVCD-XXX.
  - 2. Material: Vinyl.
  - 3. Nominal Thickness: 0.125 inch (3.2 mm).
  - 4. Striping: 2 inch (24 mm) wide contrasting color abrasive strips.
  - 5. Texture: Smooth.
- B. ALTERNATE: <RB FLR-10>: Rubber stair treads and risers. Provide the same material at landings and other locations indicated by this tag in the room finish schedule.
- C. Stair Treads: Rubber: full width and depth of stair tread in one piece; tapered thickness.
  - 1. Manufacturers:
    - a. Burke Flooring: [www.burkeflooring.com](http://www.burkeflooring.com)
    - b. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com)
    - c. Roppe Corp: [www.roppe.com](http://www.roppe.com)
    - d. Substitutions: See Section 01 2500 Substitution Procedures
  - 2. Critical Radiant Flux (CRF) Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
  - 3. Nosing: Square.
- D. Stair Risers: Full height and width of tread in one piece, matching treads in material and color.
  - 1. Thickness: 0.080 inch (2.0 mm).

### 2.04 RESILIENT BASE

- A. Resilient Base <RB BASE-#>: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style A or B, and as follows:
  - 1. Manufacturers:
    - a. Burke Flooring: [www.burkeflooring.com](http://www.burkeflooring.com).
    - b. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
    - c. Roppe Corp: [www.roppe.com](http://www.roppe.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Height, Style and Color:
    - a. <RB BASE-1>: 4 inch high with cove style; Johnsonite Clay.
    - b. <RB BASE-3>: 6 inch high with straight toeless style; Johnsonite Brown.
  - 3. Thickness: 0.125 inch (3.2 mm) thick.
  - 4. Finish: Satin.
  - 5. Length: Roll.

### 2.05 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Same material as resilient base, color to match.
- D. 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. 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 resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
  - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

- A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is fully cured.
- C. Clean substrate.
- D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Resilient Strips: Attach to substrate using adhesive.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

### **3.04 Installation - Sheet Flooring**

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

### **3.05 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 tile pattern.

### **3.06 RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Scribe and fit to door frames and other interruptions.

### **3.07 STAIR COVERINGS**

- A. Install stair coverings in one piece for full width and depth of tread.
- B. Adhere over entire surface. Fit accurately and securely.

### **3.08 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

### **3.09 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

## **END OF SECTION**



## **SECTION 09 6800 - CARPETING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Carpet, direct-glued.
- B. Accessories.

#### **1.02 REFERENCE STANDARDS**

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- C. CRI (GL) - Green Label Testing Program - Certified Products; Current Edition.
- D. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate seaming plan, method of joining seams, direction of carpet pile and pattern, location of edge moldings and edge bindings.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- D. Samples: Submit two samples 12 x 12 inch (305 x 305 mm) in size illustrating color and pattern for each carpet material specified, including bound edge.

#### **1.04 FIELD CONDITIONS**

- A. Maintain minimum 70 degrees F (21 degrees C) ambient temperature 24 hours prior to, during and 24 hours after installation.
- B. Ventilate installation area during installation and for 72 hours after installation.

### **PART 2 PRODUCTS**

#### **2.01 CARPET**

- A. Carpet <CPT-#>:
  - 1. <CPT-1>: Aqua Hospitality Carpets; Anthropology; Walnut.
  - 2. <CPT-2>: Bolyu Contract; Excursion; Tourist Attraction.
  - 3. <CPT-3>: Joy Carpets; Fast; Brown.
  - 4. <CPT-4>: Shaw Floors; Capital III; Eminence.
  - 5. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.

6. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
7. Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 CUSHION**

- A. Cushion: Cellular rubber.

## **2.03 ACCESSORIES**

- A. Sub-Floor Filler: Type recommended by carpet manufacturer.
- B. Tackless Strip: Carpet gripper, of type recommended by carpet manufacturer to suit application, with attachment devices.
- C. Adhesives:
  1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GL) certified; in lieu of labeled product, independent test report showing compliance is acceptable.
- D. Seam Adhesive: Recommended by carpet manufacturer.
- E. Carpet Adhesive: Recommended by carpet manufacturer; releasable type.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive carpet.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesives to sub floor surfaces.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and alkalinity (pH).
  1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

### **3.02 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Clean substrate.

### **3.03 INSTALLATION - GENERAL**

- A. Starting installation constitutes acceptance of sub-floor conditions.



- B. Install carpet and cushion in accordance with manufacturer's instructions.
- C. Verify carpet match before cutting to ensure minimal variation between dye lots.
- D. Lay out carpet.
  1. Locate seams in area of least traffic, out of areas of pivoting traffic, and parallel to main traffic.
  2. Do not locate seams perpendicular through door openings.
  3. Align run of pile in same direction as anticipated traffic and in same direction on adjacent pieces.
  4. Locate change of color or pattern between rooms under door centerline.
  5. Provide monolithic color, pattern, and texture match within any one area.
- E. Install carpet tight and flat on subfloor, well fastened at edges, with a uniform appearance.

#### **3.04 STRETCHED-IN CARPET**

- A. Install tackless strips with pins facing the wall around entire perimeter, except across door openings. Use edge strip where carpet terminates at other floor coverings.
- B. Space tackless strips slightly less than carpet thickness away from vertical surfaces, but not more than 3/8 inch (9 mm).
- C. Install cushion in maximum size pieces using spot adhesive to adhere to sub-floor.
- D. Lay out cushion so that seams will be perpendicular to, or offset from, minimum 6 inches (150 mm) from carpet seams.
- E. Butt cushion edges together and tape seams.
- F. Trim cushion tight to edge of tackless strip and around projections and contours.
- G. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to all cut edges immediately.
- H. Join seams by hand sewing. Form seams straight, not overlapped or peaked, and free of gaps.
- I. Following seaming, hook carpet onto tackless strip at one edge, power stretch, and hook firmly at other edges. Follow manufacturer's recommendations for method and amount of stretch.
- J. Trim carpet neatly at walls and around interruptions. Tuck edges into space between tackless strip and wall.

#### **3.05 DIRECT-GLUED CARPET**

- A. Double cut carpet seams, with accurate pattern match. Make cuts straight, true, and unfrayed. Apply seam adhesive to cut edges of woven carpet immediately.
- B. Apply contact adhesive to floor uniformly at rate recommended by manufacturer. After sufficient open time, press carpet into adhesive.
- C. Apply seam adhesive to the base of the edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.
- D. Roll with appropriate roller for complete contact of adhesive to carpet backing.

- E. Trim carpet neatly at walls and around interruptions.

### **3.06 INSTALLATION ON STAIRS**

- A. Install tackless strips at back of treads, with pins facing riser, and at bottom of riser, with pins facing tread.
- B. Install cushion on stair treads butt tight to applied nosing.
- C. Install carpet on stairs with the run of the pile in opposite direction of anticipated traffic to avoid peaking of backing at nosings.
- D. Stretch carpet over stair treads, full width in one piece. Fold carpet under 1-1/2 inches (40 mm) on each side.

### **3.07 CLEANING**

- A. Remove excess adhesive from floor and wall surfaces without damage.
- B. Clean and vacuum carpet surfaces.

### **END OF SECTION**

# SECTION 09 9113 - EXTERIOR PAINTING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. 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.
  - 2. Mechanical and Electrical:
    - a. Exterior mechanical and electrical: Paint all mechanical and electrical pipes, conduits, etc that penetrate exterior building walls, except as indicated below in paragraph D.
- 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, and operating parts of equipment.
  - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
  - 6. Marble, granite, slate, and other natural stones.
  - 7. Floors, unless specifically indicated.
  - 8. Glass.
  - 9. Concealed pipes, ducts, and conduits.

### 1.02 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting.
- B. Divisions 21 through 26: Identification for mechanical and electrical systems.

### 1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2015.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, [www.paintinfo.com](http://www.paintinfo.com).
- D. SSPC-SP 1 - Solvent Cleaning; 2015.
- E. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- F. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- G. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
  - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
  - 3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.
- 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 6000 - Product Requirements, for additional provisions.
  - 2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color, type, surface texture, and sheen; 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 five years 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 paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

## **1.07 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior 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 (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles (860 lx) 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. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  - 2. Diamond Vogel Paints: [www.diamondvogel.com](http://www.diamondvogel.com).
  - 3. PPG Paints: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 4. Pratt & Lambert Paints: [www.prattandlambert.com](http://www.prattandlambert.com).
  - 5. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).

### **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 specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
  - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- 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. Allow for minimum of six colors for each system, unless otherwise indicated, without additional cost to Owner.
  3. Extend colors to surface edges; colors may change at any edge as directed by Architect.

### **2.03 PAINT SYSTEMS - EXTERIOR**

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, primed wood, and primed metal.
  1. Two top coats and one coat primer.
  2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
  3. Primer: As recommended by top coat manufacturer for specific substrate.
  4. Masonry: One coat of block filler as recommended by top coat manufacturer for specific substrate.

### **2.04 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 effect 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. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
  2. Exterior 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 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. Concrete:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- G. Masonry:
  - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
  - 2. Prepare surface as recommended by top coat manufacturer.
- 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 using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- J. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- K. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### 3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

- C. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. 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**



## **SECTION 09 9123 - INTERIOR PAINTING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints, stains, and varnishes.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Elevator pit ladders.
  - 3. Prime surfaces to receive wall coverings.
  - 4. Mechanical and Electrical:
    - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
    - b. In finished areas, paint shop-primed items.
    - c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
    - d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
- 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. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
  - 6. Marble, granite, slate, and other natural stones.
  - 7. Floors, unless specifically indicated.
  - 8. Ceramic and other tiles.
  - 9. Glass.
  - 10. Concealed pipes, ducts, and conduits.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 09 9113 - Exterior Painting.
- B. Divisions 21 through 26: Identification for mechanical and electrical systems.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2015.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, [www.paintinfo.com](http://www.paintinfo.com).

- C. SSPC-SP 1 - Solvent Cleaning; 2015.
- D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- E. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015); 2003.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
  - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
  - 3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.
- 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 6000 - Product Requirements, for additional provisions.
  - 2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color, type, surface texture, and sheen; 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 five years 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 paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

### **1.07 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 (3 degrees C) above the dew point; or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F (10 degrees C) for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles (860 lx) 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. Benjamin Moore & Co: [www.benjaminmoore.com](http://www.benjaminmoore.com).
  - 2. Diamond Vogel Paints: [www.diamondvogel.com](http://www.diamondvogel.com).
  - 3. PPG Paints: [www.ppgpaints.com](http://www.ppgpaints.com).
  - 4. Pratt & Lambert Paints: [www.prattandlambert.com](http://www.prattandlambert.com).
  - 5. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
- C. Substitutions: See Section 01 6000 - 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. 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 specifically described in manufacturer's product instructions.

- B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- 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. Allow for minimum of six colors for each system, unless otherwise indicated, without additional cost to Owner.
  - 3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
  - 4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under, unless noted otherwise.

### **2.03 PAINT SYSTEMS - INTERIOR**

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, wood, uncoated steel, shop primed steel, and galvanized steel.
  - 1. Two top coats and one coat primer.
  - 2. Top Coat(s): Interior Latex; MPI #43, 44, 52, 53, 54, or 114.
    - a. Basis of Design Products:
      - 1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
      - 2) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eg-Shel. (MPI #52)
  - 3. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
  - 1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
  - 2. Two top coats and one coat primer.
  - 3. Top Coat(s): High Performance Architectural Interior Latex; MPI #139, 140, or 141.
    - a. Basis of Design Products:
      - 1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
      - 2) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)
  - 4. Primer: As recommended by top coat manufacturer for specific substrate.
- C. Paint I-TR -W - Transparent Finish on Wood.
  - 1. 1 top coat over sanding sealer over stain.
  - 2. Stain: Semi-Transparent Stain for Wood; MPI #90.
  - 3. Top Coat(s): Clear Water Based Varnish; MPI #128, 129, or 130.

### **2.04 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 effect 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. Gypsum Wallboard: 12 percent.
  - 2. Masonry, Concrete, and Concrete Masonry Units : 12 percent.
  - 3. Interior 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 mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces:
  - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- 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 according to SSPC-SP 6 "Commercial Blast Cleaning". 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.
- K. 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.
- L. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### **3.03 APPLICATION**

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- H. 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**

## **SECTION 10 1101 - VISUAL DISPLAY BOARDS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Markerboards and Tackboards.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Blocking and supports.

#### **1.03 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2009a (Reapproved 2016).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on markerboard, tackboard, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations, special anchor details.
- D. Samples: Submit two samples 2 by 2 inch (50 by 50 mm) in size illustrating materials and finish, color and texture of tackboard surfacing.
- E. Manufacturer's printed installation instructions.
- F. Maintenance Data: Include data on regular cleaning, stain removal .

#### **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 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Visual Display Boards:
  - 1. Claridge Products and Equipment, Inc: [www.claridgeproducts.com](http://www.claridgeproducts.com).

2. MooreCo, Inc: [www.moorecoinc.com](http://www.moorecoinc.com).
3. Polyvision Corporation (Nelson Adams): [www.polyvision.com](http://www.polyvision.com).
4. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 VISUAL DISPLAY BOARDS

- A. Markerboards <MARK BRD-1>: Porcelain enamel on steel, laminated to core.
  1. Color: As selected from manufacturer's full range.
  2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch (0.61 mm).
  3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
  4. Backing: Galvanized steel sheet, laminated to core.
  5. Size: As indicated on drawings.
  6. Frame: Extruded aluminum, with concealed fasteners.
  7. Frame Finish: Anodized, natural.
  8. Accessories: Provide chalk tray and map rail.
- B. Tackboards <TACK BRD-1>: Composition cork.
  1. Cork Thickness: 1/4 inch (6 mm).
  2. Color: As selected from manufacturer's full range.
  3. Backing: Hardboard, 1/4 inch (6 mm) thick, laminated to tack surface.
  4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
  5. Size: As indicated on drawings.
  6. Frame: Same type and finish as for markerboard.
- C. Combination Units and Units Made of More Than One Panel: Factory-assembled markerboards and tackboards in a single frame, of materials specified above.
  1. Join panels of different construction with H-shaped extruded aluminum molding finished to match frame.
  2. Join panels of similar construction with butt joints, aligned and secured with steel spline concealed in edge of core.
  3. Configuration: As indicated on drawings.
  4. Units Too Large to Ship Assembled: Fully assembled in factory, then disassembled for shipping.

## 2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- C. Steel Sheet Backing: Manufacturer's standard thickness, galvanized.
- D. Adhesives: Type used by manufacturer.

## 2.04 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch (25 mm) wide overall, full width of frame.
- B. Marker Tray: Aluminum, manufacturer's standard profile molded ends; concealed fasteners, same finish as frame.



- C. 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 INSTALLATION**

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.
- C. Butt Joints: Install with tight hairline joints.

### **3.03 CLEANING**

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Remove temporary protective cover at Date of Substantial Completion.

## **END OF SECTION**



## **SECTION 10 1400 - SIGNAGE**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Room and door signs.
- B. Building identification signs.
- C. Traffic signs.

#### **1.02 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

#### **1.04 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 this minimum temperature during and after installation of signs.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Flat Signs:
  - 1. Best Sign Systems, Inc: [www.bestsigns.com](http://www.bestsigns.com).
  - 2. Inpro: [www.inprocorp.com](http://www.inprocorp.com).
  - 3. Mohawk Sign Systems, Inc: [www.mohawksign.com](http://www.mohawksign.com).
  - 4. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).
  - 5. Gemini: [www.signletters.com](http://www.signletters.com).
  - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Dimensional Letter Signs:
  - 1. Inpro: [www.inprocorp.com](http://www.inprocorp.com).
  - 2. CCSW: [www.ccswwsignsystems.com](http://www.ccswwsignsystems.com).
  - 3. Gemini: [www.signletters.com](http://www.signletters.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 SIGNAGE APPLICATIONS**

- A. Accessibility Compliance: Signs are required to 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 comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
  - 1. Sign Type: Flat signs with applied character panel media as specified.
  - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
  - 3. Character Height: 1 inch (25 mm).
  - 4. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings.
  - 5. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
  - 6. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Address Signs:
  - 1. Provide one building street address set, matte finish, flat cut-out acrylic sheet numbers, 1/8" thick, 4" high by Gemini signs or equal; [www.geminisignletters.com](http://www.geminisignletters.com). Color as selected by Architect from the manufacturer's standard selections. Letter style as selected by Architect from manufacturer's standard selections.

- D. Traffic Signs:
  - 1. Signs shall comply with MnDOT and MN-MUTCD standards, and be manufactured from 16 gage steel. Signs shall have standard traffic symbols as indicated. Mount sign on steel post as shown in drawings. Posts shall be buried to frost level min, unless noted otherwise.
  - 2. Provide the following signs and quantities:
    - a. Accessible Parking (ST-13): 3 total (2 standard, 1 van accessible).
    - b. No Parking Loading Zone (ST-14): 2 total.
    - c. Stop Sign: 30 by 30 inches: 2 total.
- E. Building Identification Signs:
  - 1. Provide a \$10,000 allowance for the fabrication and installation of exterior building signage.

### **2.03 SIGN TYPES**

- A. Flat Signs: Signage media without frame. See drawings for materials and configuration.
  - 1. Size: 8 inches square, unless noted otherwise on the drawings.
  - 2. Edges: Bevelled.
  - 3. Corners: Square.
  - 4. Wall Mounting of One-Sided Signs: Tape adhesive for interior signs and concealed screws for exterior signs.
- B. Color and Font: Unless otherwise indicated:
  - 1. Character Font: Arial.
  - 2. Character Case: Upper case only.
  - 3. Background Color: Clear.
  - 4. Character Color: Contrasting color.

### **2.04 TACTILE SIGNAGE MEDIA**

- A. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
  - 1. Total Thickness: 1/8 inch (3 mm).
  - 2. Letter Thickness: 1/8 inch (3 mm).
  - 3. Letter Edges: Square.

### **2.05 ACCESSORIES**

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Exposed Screws: Chrome plated.
- C. Tape Adhesive: Double sided tape, permanent adhesive.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

- B. Install neatly, with horizontal edges level.
- C. Locate signs 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.

**END OF SECTION**

## **SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Accessories for toilet rooms, showers, and utility rooms.
- B. Grab bars.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 10 2113.19 - Plastic Toilet Compartments.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- E. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Toilet Accessories:
  - 1. AJW Architectural Products: [www.ajw.com](http://www.ajw.com).
  - 2. ASI - American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com).
  - 3. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
  - 4. Bobrick Washroom Equipment, Inc: [www.bobrick.com](http://www.bobrick.com).
  - 5. Substitutions: Section 01 6000 - Product Requirements.
- B. All items of each type to be made by the same manufacturer.

## 2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
  - 1. Grind welded joints smooth.
  - 2. Fabricate units made of metal sheet or seamless sheets, with flat surfaces.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Stainless Steel Tubing: ASTM A269/A269M, Type 304 or 316.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

## 2.03 FINISHES

- A. Stainless Steel: No. 4 Brushed finish, unless otherwise noted.
- B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- C. Back paint components where contact is made with building finishes to prevent electrolysis.

## 2.04 TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser <TP DISP-1>: Single roll, surface mounted bracket type, stainless steel .
  - 1. Product: Model B-76857 manufactured by Bobrick.
- B. Combination Towel Dispenser/Waste Receptacle: Recessed flush with wall, stainless steel; seamless wall flanges, continuous piano hinges, tumbler lock on door.
  - 1. Towel dispenser capacity: 350 C-Fold.
  - 2. Waste receptacle capacity: 2 gallons (7.5 liters).
  - 3. Products: Model 2291 manufactured by Bradley.
- C. Soap Dispenser <SOAP DISP-1>: Liquid soap dispenser, wall-mounted, surface, with impact-resistant polymer cover; push type soap valve.
  - 1. Minimum Capacity: 48 ounces (1.5 liters).
  - 2. Product: Model B-5050 manufactured by Bobrick.
- D. Frameless Mirrors <MIRROR-50>: Frameless, 6 mm thick mirror.
  - 1. Size: As indicated on drawings.
  - 2. Installation: Secure mirror with metal mounting clips to wall with screws, then engage mirror into clips.
  - 3. Product: 747 Series manufactured by Bradley or equal.
- E. Grab Bars <GRAB BAR-#>: Stainless steel, nonslip grasping surface finish.
  - 1. Standard Duty Grab Bars:
    - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.



- b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
    - c. Length and Configuration: As indicated on drawings.
  - 2. Provide as a Towel Bar in dwelling unit bathrooms. Two each unless noted otherwise in drawings.
  - 3. Product: 832 Series manufactured by Bradley.
- F. Robe Hook: Stainless steel, satin finish.
  - 1. Dwelling Unit Bathrooms:
    - a. 2 each centered on bathroom door at 5'-6" typical (4'-0" in accessible units).
    - b. Product: Bobrick B-6717.
  - 2. Public Restrooms:
    - a. 2 each centered on door. One at 5'-6" and one at 4'-0".
    - b. Product: Bobrick B-2116.

## 2.05 SHOWER AND TUB ACCESSORIES

- A. Shower Curtain Rod <CRTN ROD-1>: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners.
  - 1. Product: B-6047 manufactured by Bobrick.

## 2.06 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder <MOP HLDR-1>: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
  - 1. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
  - 2. Length: Manufacturer's standard length for number of holders/hooks.
  - 3. Product: 9953 manufactured by Bradley.
  - 4. Provide one in each janitor's closet, locations indicated as <MOP HLDR-1>, unless otherwise noted.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.
- D. See Section 06 1000 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

### 3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

### **3.03 INSTALLATION**

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

**END OF SECTION**

## **SECTION 10 3100 - MANUFACTURED FIREPLACES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Manufactured steel box fireplace.
- B. Insulated chimney flue and associated roof flashings.

#### **1.02 REFERENCE STANDARDS**

- A. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).
- B. UL 127 - Standard for Factory-Built Fireplaces; Current Edition, Including All Revisions.

#### **1.03 SYSTEM DESCRIPTION**

- A. Built-in firebox with concealed flue; rectangular shape; gas starter and circulating fan.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide fire box cabinet dimensions, clearances required from adjacent dissimilar construction, applicable regulatory agency approvals, electrical characteristics of fan.
- C. Shop Drawings: Indicate fire box rough opening dimensions, rough opening sizes for chimney flue, and fan size.
- D. Manufacturer's Certificate: Certify that fireplace components meet or exceed UL (DIR) requirements.
- E. Manufacturer's Instructions: Indicate installation procedures and component installation sequence, clearances and tolerances from adjacent construction.

#### **1.05 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for clearances from adjacent materials, chimney height above roof line requirements, and unit UL approval.
- B. Listed by Underwriters Laboratories Inc. (UL) as complying with UL 127.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufactured Fireplaces <FIREPLACE-1>:
  - 1. Basis of Design: Heat & Glo; Mezzo36 Loft Forge Front, black trim; [www.heatnglo.com](http://www.heatnglo.com).
  - 2. Lennox Hearth Products: [www.ihp.us.com](http://www.ihp.us.com).
  - 3. Vermont Castings: [www.vermontcastings.com](http://www.vermontcastings.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 COMPONENTS**

- A. Fire Box: Formed insulated steel cabinet, rectangular shaped interior, configured to include chimney outlet and cleanout, front air inlet and integral air outlet.
  - 1. Hearth Opening (nominal): 48 inches (1219 mm) wide by 42 inches (1066 mm) high by 18 inches (457 mm) deep.

## **PART 3 EXECUTION**

### **3.01 VERIFICATION OF CONDITIONS**

- A. Verify that prepared openings are ready to receive work and opening dimensions are as indicated on drawings.
- B. Verify that proper power supply and fuel source are available.

### **3.02 INSTALLATION**

- A. Install unit assembly in accordance with manufacturer's instructions.

## **END OF SECTION**

## **SECTION 10 4400 - FIRE PROTECTION SPECIALTIES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

#### **1.03 REFERENCE STANDARDS**

- A. FM (AG) - FM Approval Guide; current edition.
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.
- C. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, and color and finish.
- C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, and rough-in measurements for recessed cabinets.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

#### **1.05 FIELD CONDITIONS**

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Fire Extinguishers:
  - 1. Ansul, a Tyco Business: [www.ansul.com](http://www.ansul.com).
  - 2. JL Industries, Inc: [www.jlindustries.com](http://www.jlindustries.com).
  - 3. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  - 4. Pyro-Chem, a Tyco Business: [www.pyrochem.com](http://www.pyrochem.com).

5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
1. Ansul, a Tyco Business: [www.ansul.com](http://www.ansul.com).
  2. JL Industries, Inc: [www.jlindustries.com](http://www.jlindustries.com).
  3. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com).
  4. Pyro-Chem, a Tyco Business: [www.pyrochem.com](http://www.pyrochem.com).
  5. Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 FIRE EXTINGUISHERS**

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
1. Provide one fire extinguisher for each cabinet or bracket indicated on the drawings.
  2. Provide one fire extinguisher and bracket in each dwelling unit.
  3. Basis of Design: Cosmic by JL Industries.
  4. Class: A:B:C type.
  5. Size: 10 pound (4.54 kg).
  6. Finish: Baked polyester powder coat, color as selected.
  7. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to 120 degrees F (49 degrees C).

## **2.03 FIRE EXTINGUISHER CABINETS**

- A. Fire-Rated Construction: Provide fire-rated cabinets in fire-rated walls (see drawings for locations).
- B. Cabinet Configuration <FIRE CAB-1>: Semi-recessed type.
1. Size to accommodate accessories.
  2. Basis of Design: JL Industries "Ambassador Series" sized for 10 lb fire extinguisher.
  3. Projected Trim: Returned to wall surface, with 2-1/2 inch (63 mm) projection, and 1-3/4 inch (44 mm) wide face.
  4. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- C. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
- D. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.
- E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- F. Weld, fill, and grind components smooth.
- G. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.
- H. Finish of Cabinet Interior: White colored enamel.

## **2.04 ACCESSORIES**

- A. Extinguisher Brackets <FIRE BRKT-1>: Formed steel, chrome-plated.
- B. Cabinet Signage: Silk-screened vertical red lettering applied to the door - FIRE EXTINGUISHER.

- C. Fire Department Access Box:
  - 1. Acceptable manufacturers, subject to compliance with specified requirements:
    - a. Dama, S3 (surface-mount)
    - b. Dama, R3 (recessed mount)
    - c. Knox-Box, 3200 Series
    - d. Tru-Lock (recessed mount), Eau Claire, WI
  - 2. Verify manufacturer is acceptable to local Fire Department.
  - 3. Requirements:
    - a. Coordinate keying requirements with the authority having jurisdiction.
    - b. Verify surface or flush mount box with Architect.
    - c. Finish: Corrosion resistant.
  - 4. Provide one access box in a location to be determined by Architect (unless location is indicated on drawings).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

## **END OF SECTION**





## **SECTION 10 5500 - POSTAL SPECIALTIES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Central mail delivery boxes.

#### **1.02 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. 39 CFR 111 - U.S. Postal Service Standard 4C; effective date September 3, 2006.
- C. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, maintenance information, and current USPS approval documentation.
- C. Shop Drawings: Indicate plans for each unit or groups of units, front elevations with compartment layout and model number, overall dimensions, rough-in opening sizes, construction and anchorage details.

#### **1.04 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for a period of 5 years from Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 CENTRAL MAIL DELIVERY BOXES**

- A. Manufacturers:
  - 1. Florence Manufacturing Company; Versatile 4C Series: [www.florencemailboxes.com](http://www.florencemailboxes.com). (Basis of Design)
  - 2. Jensen Mailboxes: [www.jensenmailboxes.com](http://www.jensenmailboxes.com).
  - 3. Postal Products Unlimited, Inc: [www.postalproducts.com](http://www.postalproducts.com).
  - 4. Salsbury Industries: [www.mailboxes.com](http://www.mailboxes.com).
  - 5. Security Manufacturing Corp: [www.securitymanufacturing.com](http://www.securitymanufacturing.com).
  - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Central Mail Delivery Boxes: Provide products approved for United States Postal Service (USPS) delivery.
  - 1. Materials: Aluminum with stainless steel hardware.
  - 2. Finish: Powder coat in color selected by Architect from manufacturer's standard colors.
  - 3. Unit Types and Sizes: As indicated on drawings.

- 4. Configurations: See drawings for overall dimensions and layouts.
- C. Wall-Mounted Mailboxes: Fully-recessed, front load, complying with 39 CFR 111 (USPS-STD-4C).

## **2.02 COMPONENTS**

- A. Identification - Customer and Parcel Compartments: Sequential numerical or alphabetic characters, top to bottom, left to right; factory-installed.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that rough-openings are ready to receive wall-mounted units.
- B. Do not begin installation until unacceptable conditions are corrected.

### **3.02 INSTALLATION**

- A. Install postal specialties in accordance with approved shop drawings, manufacturer's instructions, and USPS requirements.
- B. Adjust and lubricate door hardware to operate properly.

## **END OF SECTION**

## **SECTION 10 5623 - WIRE STORAGE SHELVING**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Wall mounted wire closet shelving.
- B. Wall standard and bracket mounted wire closet shelving.
- C. Coat Rods
- D. Accessories.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Blocking in walls for attachment of shelving.
- B. Section 09 2116 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, with installation instructions.
- C. Shop Drawings: Provide drawings prepared specifically for this project; show dimensions of shelving and attachment to substrates.

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

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.
- C. Store flat to prevent warpage and bending.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Wire Storage Shelving <WIRE SHLV-1>:
  - 1. ClosetMaid Corporation : [www.closetmaid.com](http://www.closetmaid.com).
  - 2. RubberMaid Closet and Organization Products : [www.rubbermaidcloset.com](http://www.rubbermaidcloset.com).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 SHELVING APPLICATIONS**

- A. Shelf Depth: 12 inches (305 mm), unless otherwise indicated.
- B. Bedroom Closets.
  - 1. Wall mount 12 inch deep shelving with free-sliding integral clothes rod.
  - 2. Wall to wall.
  - 3. Mount at height indicated on the Drawings.

- C. Accessible Residence Room Closet. (ClosetMaid Shelftrack or equal)
  - 1. Wall track mounted Shelving.
  - 2. 48 inch high standards at 16 inches on center, bottom of track at 40 inches above finish floor.
  - 3. Cantilever brackets
  - 4. Adjustable Height, Bracket mounted Shelves and Clothes Rod, the full width of closet.
- D. Coat Closets:
  - 1. Wall-to-wall shelf with free sliding hanger rod.
- E. Linen Closets:
  - 1. Wall-to-wall shelves spaced at 13 inch (330 mm) vertically, not less than 16 inch (408 mm) deep.
  - 2. Coordinate bottom shelf
- F. Storage Closets:
  - 1. Wall-to-wall storage shelves, close-mesh cross wire spacing, stacked at 13 inch vertically, depth shall be the full practical depth of the closet or recess.
  - 2. Provide 24 inch deep shelves over side-by-side washer and dryer.

### 2.03 MATERIALS

- A. Wire Shelving: Factory-assembled coated wire mesh shelf assemblies for wall-mounting, with all components and connections required to produce a rigid structure that is free of buckling and warping.
  - 1. Construction: Cold-drawn steel wire with average tensile strength of 100,000 psi (690 MPa) resistance welded into uniform mesh units, square, rigid, flat, and free of dents or other distortions, with wires trimmed smooth.
  - 2. Coating: PVC or epoxy, applied after fabrication, covering all surfaces.
  - 3. PVC Coating: 9 to 11 mils (0.23 to 0.028 mm) thick.
  - 4. Epoxy Coating: Non-toxic epoxy-polyester powder coating baked-on finish, 3 to 5 mils (0.76 to 1.27 mm) thick.
  - 5. Standard Mesh Shelves: Cross deck wires spaced at 1 inch (25.4 mm).
  - 6. Shelf and Rod Units: Integral hanging rod at front edge of shelf.
  - 7. Free-Sliding Hanging Rod: Integral hanging rod that permits uninterrupted sliding of hangers the full width of the shelf.
- B. Hanging Rod: Tubular steel, 1 inch (25 mm) diameter, with end caps on open ends.
  - 1. Finish: Epoxy powder coat.
  - 2. Wall Thickness: 20 gage, 0.035 inch (0.89 mm).
  - 3. Provide corner hanging rods and hanging rod connectors where required.
  - 4. Rod may be integral with the shelving, but shall be 'free-sliding'.
- C. Wall-Mounted Standards: Vertically slotted channel standards with double-tab cantilever brackets to suit shelving; factory finished to match shelving.
- D. Mounting Hardware: Provide manufacturer's standard mounting hardware; include support braces, wall brackets, back clips, end clips, poles, and other accessories as required for complete and secure installation; factory finished to match shelving.
- E. Fasteners: As recommended by manufacturer for mounting substrates.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Inspect areas to receive shelving, to verify that spaces are properly prepared to receive shelf units, and are of dimensions indicated on shop drawings.
- B. Verify appropriate fastening hardware.
- C. Do not begin installation until substrates have been properly prepared.
- D. 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, with shelf surfaces level.
- B. Cap exposed ends of cut wires.
- C. Install back clips, end clips at side walls, and support braces at open ends. Install intermediate support braces as recommended by manufacturer.
- D. Mounting Heights:
  - 1. Single Hanging Rod Units: Install shelf at 68 inches (1727 mm) above floor.
  - 2. Double Hanging Rod Units: Install shelves at 42 inches (1067 mm) and 84 inches (2134 mm) above floor.
  - 3. Other Shelves: See drawings.

### **3.04 CLEANING**

- A. Clean soiled surfaces after installation.

## **END OF SECTION**



## **SECTION 11 3100 - RESIDENTIAL APPLIANCES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Kitchen appliances.
- B. Laundry appliances.

#### **1.02 RELATED REQUIREMENTS**

- A. Mechanical - Plumbing connections for appliances.
- B. Electrical - Electrical connections for appliances.

#### **1.03 REFERENCE STANDARDS**

- A. UL (DIR) - Online Certifications Directory; current listings at [database.ul.com](http://database.ul.com).

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Submit Certification for applicable appliances that they are in conformance with Energy Star Standards.

#### **1.05 QUALITY ASSURANCE**

- A. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).
- B. Appliance brands may be mixed overall. However within kitchens, accessible kitchens, and laundries; all appliances shall be of a single manufacturer.

#### **1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide One year manufacturer warranty on refrigeration system of refrigerators.
- C. Provide One year manufacturer warranty on ranges.
- D. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.
- E. Provide ten (10) year manufacturer warranty on tub and door liner of dishwashers.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURER**

- A. Numbers given below are a Basis of Design.
- B. Comparable products by the following manufacturers will be considered as equal.
  - 1. Frigidaire Home Products: [www.frigidaire.com](http://www.frigidaire.com).
  - 2. GE Appliances: [www.geappliances.com](http://www.geappliances.com).
  - 3. Whirlpool Corp: [www.whirlpool.com](http://www.whirlpool.com).
  - 4. Sear Contract Sales.
  - 5. Hotpoint.
- C. The Supplier/Subcontractor submitting bids on this work shall submit catalog cuts/'tear sheets' on each appliance for evaluation by the Owner.
- D. Supplier shall include all power cords, adapters, hoses, etc. required for a complete installation.
- E. Provide stainless steel hoses.

### **2.02 KITCHEN APPLIANCES**

- A. Provide Equipment Eligible for Energy Star Rating: Energy Star Rated.
- B. Refrigerator <REFRIG-#>: Free-standing, top-mounted freezer, frost-free.
  - 1. Basis of Design:
    - a. <FRIDGE-1>: GE Energy Star 18.2 cu. ft. Model GTE18ITHWW.
    - b. <FRIDGE-2>: GE Energy Star 21.2 cu. ft. Model GTE21GTHWW.
    - c. Substitutions with approval by Architect prior to bid proposal.
- C. Range <RANGE-#>: Electric, free-standing, with standard burners and removable drip pans.
  - 1. Size: 30 inches (762 mm) wide.
  - 2. Oven: Self-cleaning.
  - 3. Elements: Four (4).
  - 4. Controls: Push-to-turn knobs with electronic clock and timer and lock out feature.
  - 5. Features: Include storage drawer, oven door window, and oven light.
  - 6. Exterior Finish: Porcelain enameled steel, color as indicated.
  - 7. Basis of Design:
    - a. <RANGE-1> Type B Units: GE Model JB250DFWW.
    - b. <RANGE-2> Type A Units: GE Model JBS45DFWW.
    - c. Substitutions with approval by Owner prior to bid proposal.
- D. Cooking Exhaust <RANGE HD-1>: Range hood.
  - 1. Size: 30 inches (762 mm) wide.
  - 2. Fan: Two-speed, 500 cfm (236 L/s)
  - 3. Exhaust: Rectangular, vented to exterior. Connect to ductwork furnished by Mechanical Contractor.
  - 4. Features: Include cooktop light, backdraft damper, and removable grease filter.
  - 5. Exterior Finish: Painted steel, color as indicated.
  - 6. Basis of Design:
    - a. GE Appliances; JVX3300DJWW: [www.geappliances.com](http://www.geappliances.com). At Type "A" and Community Room with wall mounted controls.



- b. Substitutions: See Section 01 6000 - Product Requirements.
- E. Microwave <MICROWAVE-#>: Countertop.
- 1. Features: Include turntable and cooktop light.
  - 2. Basis of Design:
    - a. <MICROWAVE-2> GE Appliances; Model JES1460DSWW: [www.geappliances.com](http://www.geappliances.com).
    - b. <MICROWAVE-3> GE Appliances; Model PEM31DFWW: [www.geappliances.com](http://www.geappliances.com).
    - c. Substitutions with approval by Owner prior to bid proposal.
- F. Dishwasher <DISHWASHER-#>.
- 1. Provide Energy Star rated appliance.
  - 2. Basis of Design:
    - a. <DISHWASHER-1> GE Appliances; Model GSD3301KWW: [www.geappliances.com](http://www.geappliances.com).
    - b. <DISHWASHER-2> GE Appliances; Model GLDT690JWW: [www.geappliances.com](http://www.geappliances.com).
    - c. Substitutions with approval by Owner prior to bid proposal.

### **2.03 LAUNDRY APPLIANCES**

- A. Clothes Washer <WASHER-#>.
- 1. Provide Energy Star rated appliances.
  - 2. Basis of Specification:
    - a. <WASHER-1>: Top loading GE Model GTW485ASJWS.
    - b. <WASHER-2>: Front loading Frigidaire Model FFFW5000QW. Provide matching pedestal.
    - c. Substitutions with approval by Owner prior to bid proposal.
- B. Clothes Dryer <DRYER-#>: Electric, stationary.
- 1. Basis of specification:
    - a. <DRYER-1>: GE Model GFD48ESSKWW.
    - b. <DRYER-2>: Frigidaire Model FFQE5000QW
    - c. Substitutions with approval by Owner prior to bid proposal.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify utility rough-ins are provided and correctly located.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Provide all power cords.
- C. Provide all dryer venting in accordance with local codes.
- D. Provide all drain, water supply, and discharge hoses.

### **3.03 ADJUSTING**

- A. Adjust equipment to provide efficient operation.

### **3.04 CLEANING**

- A. Remove packing materials from equipment and properly discard.
- B. Remove packing materials from construction site.
- C. Wash and clean equipment.

**END OF SECTION**

## **SECTION 12 2113 - HORIZONTAL LOUVER BLINDS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Horizontal slat louver blinds.
- B. Operating hardware.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating physical and dimensional characteristics.
- C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- D. Samples: Submit two samples, 6 inch (152 mm) long illustrating slat materials and finish, cord type and color.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Slats: 20 of each type and size.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Horizontal Louver Blinds:
  - 1. Bali Blinds: [www.baliblinds.com](http://www.baliblinds.com).
  - 2. Hunter Douglas: [www.hunterdouglas.com](http://www.hunterdouglas.com).
  - 3. Levolor Contract: [www.levolorcontract.com](http://www.levolorcontract.com).
  - 4. SWFcontract, a division of Spring Window Fashions, LLC.: [www.swfcontract.com](http://www.swfcontract.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 BLINDS**

- A. Description <BLINDS-10>: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.
- B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.

- C. Metal Slats: Spring tempered pre-finished aluminum; radiused slat corners, with manufacturing burrs removed.
  - 1. Width: 1 inch (25 mm).
  - 2. Thickness: 0.008 inch (0.20 mm).
  - 3. Color: White.
  - 4. Basis of Design: Bali Blinds Customiser.
- D. Slat Support: Woven polypropylene cord, ladder configuration.
- E. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
  - 1. Color: Same as slats.
- F. Headrail Attachment: Wall brackets.

### **2.03 FABRICATION**

- A. Determine sizes by field measurement.
- B. Fabricate blinds to fit within openings with uniform edge clearance of 1/2 inch (13 mm).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed. See Section 06 1000.

### **3.02 INSTALLATION**

- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with concealed fasteners.

### **3.03 TOLERANCES**

- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch (6 mm).
- B. Maximum Offset From Level: 1/8 inch (3 mm).

### **3.04 ADJUSTING**

- A. Adjust blinds for smooth operation.

### **3.05 CLEANING**

- A. Clean blind surfaces just prior to occupancy.

## **END OF SECTION**

## **SECTION 12 2116 - VERTICAL LOUVER BLINDS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Vertical louver blinds at all sliding doors and adjacent fixed glazing.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
- B. Section 12 2113 - Horizontal Louver Blinds.

#### **1.03 REFERENCE STANDARDS**

- A. WCMA A100.1 - Safety of Corded Window Covering Products; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Certification: Provide certification that product complies with WCMA A100.1.
- D. Shop Drawings: Indicate headrail location and schematic wire diagram of electronic controls and motors.
- E. Selection Samples: For vanes, color chips or material samples representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For vanes, minimum size 6 inches (150 mm) square, representing actual materials, color and perforations.
- G. Operation and Maintenance Data: Manufacturer's data on repair and replacement of vanes, chains, and other parts.

#### **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 this type with minimum 3 years of documented experience.

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

- A. If blinds are delivered early and stored at the project, deliver in unopened containers; handle and store in such a manner to protect them from damage.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Vertical Louver Blinds:
  - 1. Hunter Douglas: [www.hunterdouglas.com](http://www.hunterdouglas.com).
  - 2. Levolor Contract: [www.levolorcontract.com](http://www.levolorcontract.com).
  - 3. Graber, division of Springs Window Fashions: [www.graberblinds.com](http://www.graberblinds.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 BLINDS AND BLIND COMPONENTS**

- A. Vertical Louver Blinds: Horizontal travel, vertical vane louver units complete with tracks, pivot and traversing mechanisms, and accessories, as follows:
  - 1. Basis of Design: Graber Model G-85.
  - 2. Vanes: Aluminum vanes of the size indicated.
  - 3. Operation: Manual.
  - 4. Direction of Travel: As indicated on the drawings.
  - 5. Mounting: Inside (between jambs).
  - 6. Cord and Chain Operation: Comply with WCMA A100.1.
- B. Tracks: Channel tracks as required for type of operation, extruded aluminum with clear anodized finish, with end caps.
  - 1. Vane Rotation: Chain driven direct rotation by activating tilt gear within end cap assembly in turn actuating tilt rod and worm-and-spur gears in carrier trucks.
  - 2. Operating Components: Internally mounted heavy-duty extruded aluminum tilt rod, vane carriers, and other components required for proper performance and designed for smooth, quiet, trouble free operation.
  - 3. Pivot Mechanism: Geared for synchronous 180 degrees rotation of vanes and type of operation indicated.
  - 4. Vane Carriers: Metal carriers with ball-bearing wheels or thermoplastic trucks, equipped with linkages or other devices to ensure positive spacing of vanes.
  - 5. Tilt Chain: Nickel plated brass beaded ball chain, minimum 1/8 inch (3 mm) diameter; locate at drawback side of units as indicated.
- C. Aluminum Vanes: Flat, 2 inches (50mm) wide.
  - 1. Pattern, Color, and Texture: White.
- D. Brackets and Mounting Hardware: As recommended by manufacturer for the mounting configuration and span indicated; provide manufacturer's standard L- bracket with clip for outside mounting and clip only for inside mounting.

### **2.03 FABRICATION**

- A. Field measure finished openings prior to ordering or fabrication.
- B. Fabricate blinds to fit openings within specified tolerances.
  - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom of vanes and finish floor.
  - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. Dimensional Tolerances: Fabricate blinds to within plus/minus 1/8 inch (3 mm) of intended dimensions.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not start installation before openings are finished and all finishes have been completed; do not install until painting is completed.
- B. Field measure finished openings prior to ordering or fabrication.

### **3.02 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Coordinate the work with window installation and placement of concealed blocking to support blinds.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions using mounting style as indicated.
- B. Installation Tolerances:
  - 1. Maximum Offset From Level: 1/16 inch (1.5 mm).
- C. Adjust blinds for smooth operation.
- D. Replace blinds that exceed specified dimensional tolerances at no extra cost to Owner.

### **3.04 CLEANING**

- A. Clean installed work to like-new condition.

### **3.05 PROTECTION**

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

## **END OF SECTION**





## **SECTION 12 3530 - RESIDENTIAL CASEWORK**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Kitchen cabinets.
- B. Vanity cabinets.
- C. Casework hardware.
- D. Installation of pulls.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 12 3600 - Countertops.

#### **1.03 REFERENCE STANDARDS**

- A. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- B. KCMA A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets; 2012.
- C. KCMA (DIR) - Directory of Certified Cabinet Manufacturers; current edition, online.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions and construction details.
- C. Shop Drawings: Indicate casework locations, scale plans, elevations, clearances required, rough-in and anchor placement dimensions and tolerances, and hardware pull samples.

#### **1.05 QUALITY ASSURANCE**

- A. Products: Complying with KCMA A161.1 and KCMA Certified.
- B. Manufacturer: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Residential Casework:
  - 1. Advanta, Coronet Premier Series: Product (Basis of Design): [www.advantacabinets.com](http://www.advantacabinets.com).
  - 2. Substitutions: See Section 01 2500 - Substitution Procedures

#### **2.02 COMPONENTS**

- A. Countertops: As specified in Section 12 3600.

- B. Countertop Island Support: Tapered & Fluted 3-1/2" x 3-1/2" x 34-1/2" Colonial Turned Leg by Holdahl Company or approved equal.
- C. Door and Drawer Fronts: Solid wood.
- D. Solid Oak Drawer fronts
- E. 3/4" x 1 1/2" solid oak face frames.
- F. 6-way adjustable hinges on all doors.
- G. 3/8" plywood or 1/2" furniture board side and back cabinet box panels.
- H. Solid 1/2" drawers with dovetail corner construction.
- I. Panel-style oak doors with wood veneer flat panel
- J. Door style: Raised panel.
- K. Vanity Casework (First floor half-baths):
  1. Basis of Design: IKEA Lillangen sink cabinet with stainless steel leg frame.
  2. Coordinate with Mechanical to ensure the specified sink is the correct size and configuration for the vanity.
  3. Finish: White aluminum with stainless steel doors and obscure door glazing.

### **2.03 HARDWARE**

- A. Hardware: Manufacturer's standard.
- B. Shelf Standards and Rests: Manufacturer's standard.
- C. Pulls Basis of Design: Gatehouse 3" Satin Nickel cabinet pulls by Lowe's.
- D. Catches: Magnetic.
- E. Drawer Slides: Extension arms, steel and ball bearing construction.
- F. Hinges: Manufacturer's Standard, self close.

### **2.04 FABRICATION**

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fabricate corners and joints without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
- C. If using composite wood that does not comply with ANSI A208, all exposed edges and sides must be sealed with low-VOC sealants.

### **2.05 FINISHES**

- A. Exposed To View Surfaces: Stain, seal, and varnish of the following color:
  1. <RES CASE-1>: Mocha.

2. <RES CASE-2>: Honey.
- B. Interior Surfaces: Melamine facing of white or manufacturer's standard laminate finish.
  - C. Verify all finishes with the Owner.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install casework, components and accessories in accordance with manufacturer's instructions.
- B. Set casework items plumb and square, securely anchored to building structure.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (1 mm). Use filler strips; not additional overlay trim for this purpose.
  1. All scribe or filler strips shall be of the same material of the cabinet face frames, furnished by the casework supplier.
- D. Close ends of units, back splashes, shelves and bases.

### **3.02 ADJUSTING**

- A. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

### **3.03 CLEANING**

- A. Clean casework, countertops, shelves, and hardware.
- B. Vacuum clean all interior surfaces of all sawdust and excess material. Final wipedown of cabinet interiors shall be by Owner's forces.

## **END OF SECTION**



## **SECTION 12 3600 - COUNTERTOPS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 06 4100 - Architectural Wood Casework.
- B. Division 22 - Plumbing fixtures, sinks.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. PS 1 - Structural Plywood; 2009.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Installation Instructions: Manufacturer's installation instructions and recommendations.
- F. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

#### **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 <PLAM CTOP-1>: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
  - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch (1.2 mm) nominal thickness.
    - a. Manufacturers:
      - 1) Formica Corporation: [www.formica.com](http://www.formica.com).
      - 2) Lamin-Art, Inc: [www.laminart.com](http://www.laminart.com).
      - 3) Panolam Industries International, Inc.\Nevamar: [www.nevamar.com](http://www.nevamar.com).
      - 4) Panolam Industries International, Inc.\Pionite: [www.pionitelaminates.com](http://www.pionitelaminates.com).
      - 5) Wilsonart: [www.wilsonart.com](http://www.wilsonart.com).
      - 6) Substitutions: See Section 01 6000 - 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. Finish: Matte or suede, gloss rating of 5 to 20.
    - d. Surface Color and Pattern: As selected by Architect from the manufacturer's Wilsonart Milano Amber line.
  - 2. Exposed Edge Treatment: Molded rubber edge sized to completely cover edge of panel.
    - a. Color: As selected by Architect from the manufacturer's full line.
  - 3. Back and End Splashes: Same material, same construction.
    - a. Provide where indicated on the Drawings.
  - 4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.
- C. Solid Surfacing Countertops <SSURF CTOP-21>: Solid surfacing sheet or plastic resin casting over continuous substrate.
  - 1. Flat Sheet Thickness: 1/2 inch (12 mm), 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) Avonite Surfaces: [www.avonitesurfaces.com](http://www.avonitesurfaces.com).
      - 2) Central Marble.
      - 3) Dupont: [www.corian.com](http://www.corian.com).
      - 4) Formica Corporation: [www.formica.com](http://www.formica.com).
      - 5) Wilsonart: [www.wilsonart.com](http://www.wilsonart.com).

- 6) Substitutions: See Section 01 6000 - 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. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
- d. Color and Pattern: Central Marble 965 White.
3. Other Components Thickness <SOLID SURF-20>: 1/2 inch (12 mm), minimum.
  - a. Color: Central Marble 965 White.
4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.

## **2.02 MATERIALS**

- A. Wood-Based Components:
  1. Wood fabricated from old growth timber is not permitted.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- C. Countertop Support Members: Furniture grade, epoxy powder coated steel.
  1. Basis of Design: Rakks Model EH-1818FM with cover bracket as manufactured by Rangine Corporation or approved equal.
- D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

## **2.03 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 (25 mm) except where top butts against cabinet or wall.
  3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- 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 (102 mm), unless otherwise indicated.
  3. Detail top of backsplash to allow scribing of backsplash to wall.
- C. Solid Surfacing: Fabricate tops up to 144 inches (3657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.03 INSTALLATION**

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch (16 mm).
- C. Attach countertops using compatible adhesive as well as mechanical fasteners.
- D. Seal joint between back/end splashes and vertical surfaces.

### **3.04 CLEANING**

- A. Clean countertops surfaces thoroughly.

### **3.05 PROTECTION**

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

## **END OF SECTION**



## **SECTION 12 4813 - ENTRANCE FLOOR MATS AND FRAMES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Rubber mat.
- B. Recessed mat frames.

#### **1.02 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating properties of walk-off surface, component dimensions and recessed frame characteristics.
- C. Shop Drawings: Indicate dimensions and details for recessed frame.
  - 1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.
- D. Maintenance Data: Include cleaning instructions, stain removal procedures.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Floor Mats <FLR MAT-1>:
  - 1. American Floor Products Company, Inc: [www.afco-usa.com](http://www.afco-usa.com).
  - 2. Babcock-Davis: [www.babcockdavis.com/sle](http://www.babcockdavis.com/sle).
  - 3. Nystrom, Inc: [www.nystrom.com/sle](http://www.nystrom.com/sle).
  - 4. R.C. Musson Rubber Co: [www.mussonrubber.com](http://www.mussonrubber.com).
  - 5. Pawling Corporation: [www.pawling.com](http://www.pawling.com).
  - 6. Reese Enterprises, Inc: [www.reeseusa.com](http://www.reeseusa.com).
  - 7. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 MATS**

- A. Roll-up Mat: Tread rails shall be 6063-T52 aluminum spaced 2 inches on center and connected with polypropylene thermoplastic rubber hinges/footpads with 1 x 3/16 inch slotted holes for maximum drainage.
  - 1. Rolling load capacity: 400 lbs. per wheel.
  - 2. Tread Insert: Nylon Carpet; midnight color.
  - 3. Basis of Design: Reese Perfect Mat.
- B. Recessed Frame: 1/2 inch (13 mm) thick aluminum or zinc exposed top strip, aluminum or zinc coated steel concealed bottom strip, 1/2 inch (13 mm) deep, with anchoring features.

#### **2.03 FABRICATION**

- A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.

- B. Fabricate mats in single unit sizes; fabricate multiple mats where indicated.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that floor opening for mats are ready to receive work.

#### **3.02 PREPARATION**

- A. Mats: Verify size of floor recess before fabricating mats.

- B. Vacuum clean floor recess.

#### **3.03 INSTALLATION**

- A. Install frames to achieve flush plane with finished floor surface.

- B. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

### **END OF SECTION**

## **SECTION 14 2400 - HYDRAULIC ELEVATORS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Complete hydraulic elevator systems.
  - 1. Passenger type.
- B. Elevator Maintenance Contract.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 05 5000 - Metal Fabrications: Includes elevator pit ladder, sill supports, and overhead hoist beams.
- B. Section 07 8400 - Firestopping: Fire rated sealant in hoistway.
- C. Section 09 2116 - Gypsum Board Assemblies: Gypsum shaft walls.
- D. Section 09 6813 - Tile Carpeting: Floor finish in car.
- E. Section 26 0534 - Conduit:
- F. Section 26 2717 - Equipment Wiring:

#### **1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. AISC 360 - Specification for Structural Steel Buildings; 2010.
- C. ASME A17.1 - Safety Code for Elevators and Escalators; 2013.
- D. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks; 2014.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015 (Errata 2016).
- G. NEMA MG 1 - Motors and Generators; 2014.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate work with other installers to provide conduits necessary for installation of wiring including but not limited to:
    - a. Elevator equipment devices remote from elevator machine room or hoistway.

- b. Elevator pit for lighting and sump pump.
  - c. Fire alarm panel from controller cabinet.
- B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
  - 1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
- C. Construction Use of Elevator: Not permitted.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on following items:
  - 1. Signal and operating fixtures, operating panels, and indicators.
  - 2. Car design, dimensions, layout, and components.
  - 3. Car and hoistway door and frame details.
  - 4. Electrical characteristics and connection requirements.
- C. Shop Drawings: Submit drawings and details on following items:
  - 1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
  - 2. Hoistway Components: Size and location of car guide rails, buffers, jack unit and other components.
  - 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
  - 4. Clearances and over-travel of car.
  - 5. Locations in hoistway of traveling cables and connections for car lighting and telephone.
  - 6. Location and sizes of hoistway and car doors and frames.
  - 7. Electrical characteristics and connection requirements.
  - 8. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
- D. Samples: Submit samples illustrating car interior finishes, car and hoistway door and frame finishes, and handrail material and finish in the form of cut sheets or finish color selection brochures.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Initial Maintenance Contract.
- G. Maintenance Contract: Submit proposal to Owner for standard five year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
  - 1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.
- H. Operation and Maintenance Data:
  - 1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
  - 2. Operation and maintenance manual.

3. Schematic drawings of equipment and hydraulic piping, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and approved by elevator equipment manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

#### **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty for elevator operating equipment and devices for five years from Date of Substantial Completion.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Basis of Design - Hydraulic Elevators: 330A by Schindler Elevator; [www.schindler.com](http://www.schindler.com).
- B. Other Acceptable Manufacturers - Hydraulic Elevators:
  1. Otis Elevator Company: [www.otis.com](http://www.otis.com).
  2. ThyssenKrupp Elevator: [www.thyssenkruppelevator.com](http://www.thyssenkruppelevator.com).
- C. Substitutions: See Section 01 6000 - Product Requirements.
- D. Products other than Basis of Design are subject to compliance with specified requirements and prior approval of Architect. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- E. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

#### **2.02 HYDRAULIC ELEVATORS**

- A. Hydraulic Passenger Elevator:
  1. Hydraulic Elevator Equipment:
    - a. Holeless hydraulic with cylinder mounted within hoistway.
  2. Drive System:
    - a. Variable voltage variable frequency (VVVF) to modulate motor speed.
  3. Operation Control Type:
    - a. Selective Collective Automatic Operation Control.
  4. Interior Car Height: 96 inch (2438 mm).
  5. Electrical Power: 208 volts; alternating current (AC); three phase; 60 Hz.
  6. Rated Net Capacity: 3500 lbs (1590 kgs).

7. Rated Speed: 125 to 150 feet per minute (0.63 to 0.75 m per second).
8. Hoistway Size: As indicated on drawings.
9. Interior Car Platform Size: As indicated on drawings.
10. Elevator Pit Depth: 70 inch (1778 mm).
11. Overhead Clearance at Top Floor: 140 inch (3555 mm).
12. Travel Distance: As indicated on drawings.
13. Number of Stops: As indicated on drawings.
14. Number of Openings: 5 Front; 1 Rear.
15. Hydraulic Equipment Location: As indicated on drawings

### **2.03 COMPONENTS**

- A. Elevator Equipment:
  1. Motors, Hydraulic Equipment, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70. Refer to Section 26 2717
  2. Guide Rails, Cables, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
  3. Buffers:
    - a. Spring type for elevators with speed less than or equal to 200 feet per minute (1 m per second).
  4. Lubrication Equipment:
    - a. Provide grease fittings for periodic lubrication of bearings.
    - b. Grease Cups: Automatic feed type.
    - c. Lubrication Points: Visible and easily accessible.
- B. Electrical Equipment:
  1. Motors: NEMA MG 1.
  2. Boxes, Conduit, Wiring, and Devices: As required by NFPA 70. Refer to Sections 26 0534 and 26 2717.
  3. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.
  4. Include wiring and connections to elevator devices remote from hoistway. Refer to Section 877.

### **2.04 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with ASME A17.1.
- B. Accessibility Requirements: Comply with ADA Standards. Able to accommodate a 24" x 84" ambulance stretcher compliant with the Minnesota State Building Code.
- C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
- D. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- E. Fabricate and install door and frame assemblies in accordance with NFPA 80 and in compliance with requirements of authorities having jurisdiction.
- F. Perform electrical work in accordance with NFPA 70.

### **2.05 OPERATION CONTROLS**

- A. Elevator Controls: Provide landing operating panels and landing indicator panels.

1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
  2. Landing Indicator Panels: Illuminating.
  3. Comply with ADA Standards for elevator controls.
- B. Interconnect elevator control system with building fire alarm and smoke alarm systems.
- C. Door Operation Controls:
1. Program door control to open doors automatically when car arrives at floor landing.
  2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
  3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.
- D. Provide "Firefighter's Emergency Operation" in accordance with ASME A17.1.
1. Designated Landing: At first floor.

## **2.06 OPERATION CONTROL TYPE**

- A. Selective Collective Automatic Operation Control: Applies to car in single elevator shaft.
1. Refer to description provided in ASME A17.1.
  2. Automatic operation by means of one button in the car for each landing served and by "UP" and "DOWN" buttons at the landings.
  3. Stops are registered by momentary actuation of landing car buttons without consideration of the number of buttons actuated or the sequence buttons are actuated, but the stops are made in the order that landings are reached in each direction of travel.
  4. All "UP" landing calls are made when car is traveling in the up direction.
  5. All "DOWN" landing calls are made when car is traveling in the down direction.
  6. Uppermost and lowermost calls are answered as soon as they are reached without consideration of the car travel direction.

## **2.07 EMERGENCY POWER**

- A. Set-up elevator operation to run with elevator emergency power supply when the normal building power supply fails.
- B. Elevator Emergency Power Supply: Supplied by battery backup; provide elevator system components as required for emergency power characteristics.
- C. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.
- D. Provide operational control circuitry for adapting the change from normal to emergency power.
- E. Upon transfer to emergency power, advance one elevator at a time to a pre-selected landing, stop car, open doors, disable operating circuits, and hold in standby condition.

## **2.08 MATERIALS**

- A. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated.
- B. Ceramic Tile Flooring: As specified in Section 09 3000.

## **2.09 CAR AND HOISTWAY ENTRANCES**

- A. Elevator, No. 1:

1. Car and Hoistway Entrances, Main Elevator Lobby:
  - a. Framed Opening Finish and Material: Alkyd enamel on steel.
  - b. Car Door Material: Powder coat on steel, with rigid sandwich panel construction.
  - c. Hoistway Door Material: Powder coat on steel, with rigid sandwich panel construction.

## **2.10 CAR EQUIPMENT AND MATERIALS**

- A. Elevator Car, No. 1:
  1. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
    - a. Panel Material: Integral with front return; one per car.
    - b. Car Floor Position Indicator: Above door with illuminating position indicators.
    - c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch (1.372 m) above car finished floor.
  2. Front Return Panel: Stainless steel.
  3. Door Wall: Stainless steel.
  4. Side Walls: Plastic laminate on plywood.
  5. Rear Wall: Plastic laminate on plywood.
  6. Hand Rail: Stainless steel, at rear wall. 4 inches wide. Must be ADA compliant.
    - a. Stainless Steel Finish: No. 4 Brushed.
  7. Ceiling: Stainless Steel.

## **2.11 FINISHES**

- A. Powder Coat on Steel: Clean and degrease metal surface; apply one coat of primer; two coats of powder coat.
- B. Finish Paint for Metal Surfaces: Alkyd enamel, semi-gloss, color as selected, complying with VOC limitations of authorities having jurisdiction.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting this work.
- B. Verify that hoistway and pit are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of correct characteristics.

### **3.02 PREPARATION**

- A. Arrange for temporary electrical power for installation work and testing of elevator components.
- B. Maintain elevator pit excavation free of water.
- C. Maintain in-ground elevator shaft excavation free of water.



### **3.03 INSTALLATION**

- A. Coordinate this work with installation of hoistway wall construction.
- B. Install system components, and connect equipment to building utilities.
- C. Provide conduit, electrical boxes, wiring, and accessories. Refer to Sections 26 0534 and 26 2717.
- D. Install hydraulic piping between cylinder and pump unit.
- E. Mount machines, motors, and pumps on vibration and acoustic isolators.
  - 1. Place on structural supports and bearing plates.
  - 2. Securely fasten to building supports.
  - 3. Prevent lateral displacement.
- F. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
- G. Install guide rails to allow for thermal expansion and contraction movement of guide rails.
- H. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
- I. Bolt brackets to inserts placed in concrete form work.
- J. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
- K. Fill hoistway door frames solid with grout in accordance with Section 04 2000.
- L. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- M. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.
- N. Adjust equipment for smooth and quiet operation.

### **3.04 TOLERANCES**

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
- B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Testing and inspection by regulatory agencies certified in accordance with ASME QEI-1 will be performed at their discretion.
  - 1. Schedule tests with agencies and notify Owner and Architect.
  - 2. Document regulatory agency tests and inspections in accordance with requirements.
  - 3. Perform tests required by regulatory agencies.
  - 4. Furnish test and approval certificates issued by authorities having jurisdiction.

- C. Perform testing and inspection in accordance with requirements.
  - 1. Perform tests as required by ASME A17.2.
  - 2. Provide at least two weeks written notice of date and time of tests and inspections.
  - 3. Supply instruments and execute specific tests.

### **3.06 ADJUSTING**

- A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
- B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch (6.4 mm) maximum from flush with sill.

### **3.07 CLEANING**

- A. Remove protective coverings from finished surfaces.
- B. Clean surfaces and components in accordance with manufacturers written instructions.
- C. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

### **3.08 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Demonstrate proper operation of equipment to Owner's designated representative.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Briefly describe function, operation, cleaning and maintenance of each component.
- D. Training: Train Owner's personnel on cleaning and operation and maintenance of system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.

### **3.09 PROTECTION**

- A. Do not permit construction traffic within car after cleaning.
- B. Protect installed products until Date of Substantial Completion.
- C. Touch-up, repair, or replace damaged products and materials prior to Date of Substantial Completion.

### **3.10 MAINTENANCE**

- A. Refer to Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to initial maintenance service.
- B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for five years from Date of Substantial Completion .
- C. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or original installer.

- D. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.
- E. Examine system components periodically.
- F. Include systematic examination, adjustment, and lubrication of elevator equipment.
- G. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
- H. Perform work without removing cars from use during peak traffic periods.
- I. Provide emergency call back service during regular working hours throughout period of this maintenance contract.

**END OF SECTION**



## **SECTION 14 9100 - FACILITY CHUTES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Gravity chutes for waste materials (trash and refuse).

#### **1.02 RELATED REQUIREMENTS**

#### **1.03 REFERENCE STANDARDS**

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; 2016.
- C. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2014.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for additional requirements.
- B. Product Data: Manufacturer's printed data sheets on each component, indicating which options are provided.
- C. Shop Drawings: Provide detailed layout of chute and components, indicating interface with structure, enclosing walls, and utilities; include the following:
  - 1. Openings in floors and required clearances.
  - 2. Location and size of each field connection to structure.
  - 3. Electrical wiring sizes, conduits, and location of connections.
  - 4. Clearly indicate components required but not furnished by chute installer.
- D. Test Reports: Submit for each test/inspection .
- E. Certificates: Certify that chute assembly meets or exceeds NFPA 82 and other specified requirements.
- F. Operation and Maintenance Data: Manufacturer's operation instructions.
  - 1. See Section 01 7800 - Closeout Submittals, for additional requirements.
  - 2. Include control wiring diagrams.

#### **1.05 QUALITY ASSURANCE**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Products Requiring Electrical Connection: Listed and classified by UL (DIR), ITS (DIR), or testing agency acceptable to authorities having jurisdiction as suitable for the purpose specified and indicated.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Facility Chutes:

1. Chutes International, Inc: [www.chutesinternational.com](http://www.chutesinternational.com).
2. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 FACILITY CHUTES

- A. Waste Materials and Recyclables Chutes: Sheet metal, round, constant diameter extending from above roof to lowest floor, with chute intake doors at each floor and bottom of chute discharge door into designated room as indicated on drawings; complying with requirements of NFPA 82, and the local building code and authorities having jurisdiction.
1. Chute Diameter: 30 inches (762 mm) inside.
  2. Intake Doors: Hopper type, self-closing and self-latching, with electric interlock.
  3. Intake Door Size: 15 inch wide by 18 inch high (381 mm wide by 457 mm high), nominal.
  4. Provide electric interlock system and sensors that automatically prevents the following:
    - a. Opening of any other chute intake doors at the same time.
    - b. Opening of any chute intake doors when temperature in chute exceeds predetermined, adjustable temperature.
    - c. Opening of any chute intake doors when spray cleaning is in progress.

## 2.03 COMPONENTS

- A. Chute: Factory-fabricated to the greatest extent possible, with continuously welded or lock-seamed joints and smooth, non-slag interior (no protruding bolts, rivets, hardware, sharp edges or corners).
1. Material: Stainless steel sheet.
  2. Sheet Metal Thickness: 16 gage, 0.06 inch (1.5 mm).
  3. Fire Rating: In compliance with local building code requirements.
  4. Throat Sections: Provide sloped throat sections for chute intake doors, of same material and construction as chute.
  5. Fabricate with support frames at each floor with sound isolator pads and expansion joints in chute between each support point.
- B. Chute Intake Doors: Factory-assembled, UL (DIR) listed and labeled door and frame, with self- or automatic-closing and positive latching; frame designed for chase construction, and flush-mounted.
1. Material: Stainless steel, brushed or satin finish.
  2. Fire Rating: In compliance with local building code requirements.
  3. Pulls: T-handle or lever handle latch; polished stainless steel.
  4. Signs: Mark on frame or door face the purpose of the chute, using engraving, integral raised lettering, or other permanent signs.
- C. Chute Discharge Doors: Factory-assembled, UL (DIR) listed and labeled door and frame, with self- or automatic-closing and positive latching, upon activation of smoke detector or fusible link; style as required for facility chute configuration indicated.
1. Material: Aluminum-coated steel
  2. Fire Rating: In compliance with local building code requirements.
  3. Vertical Discharge Style: Inclined horizontally rolling shutter, closing by gravity.
- D. Chute Access Doors: Same construction and fire rating as chute intake doors, with locks; provide wherever equipment requiring maintenance is located inside chute, including sprinklers, plumbing and electrical connections.
- E. Chute Intake and Access Door Locks: Mortise or rim cylinder locks keyed alike; key removable only when door is locked.
1. Chute Access Doors: Provide two keys for each door.

- F. Roof Vent: Full diameter, extending minimum 48 inches (1220 mm) above roof level, with roof deck flange.
  - 1. Material: Manufacturer's standard.
  - 2. Counterflashing and clamping ring of non-ferrous metal compatible with chute material.
  - 3. Top Unit: Screened vent.
  
- G. Fire Suppression Sprinklers: Comply with requirements of NFPA 82 and NFPA 13; provide 1/2 inch NPS (15 DN) sprinkler heads mounted inside chute intake throats at following locations:
  - 1. At or above the top intake opening.
  - 2. At the lowest intake opening.
  - 3. In buildings of more than two stories, at every other floor.
  
- H. Electrical Controls: 110 VAC.

## **PART 3 EXECUTION**

### **3.01 INTERFACE WITH OTHER WORK**

- A. Complete facility chutes and equipment installation and testing before completion of the enclosing construction.
  
- B. Coordinate sprinkler and spray cleaning devices with size, location and installation of service utilities.
  
- C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

### **3.02 INSTALLATION**

- A. Install facility chutes and equipment in accordance with NFPA 82, requirements of local authorities having jurisdiction, and manufacturer's instructions.
  
- B. Maintain fire-resistive capacity of enclosing walls.
  
- C. Install facility chute plumb and without offsets or obstructions that might prevent free fall of materials, except where indicated on drawings.
  
- D. Anchor securely in manner required to withstand impact and weight of materials in chute.
  
- E. Install roof vent flange to roof deck prior to installation of roofing.
  
- F. Install counterflashing after roofing installation.
  
- G. Adjust doors and other operating components for smooth operation.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
  
- B. Place bagged material of expected size in chute to verify free fall.
  
- C. Test the facility chute components for proper operation.
  - 1. Operate doors, locks, and interlocks.
  - 2. Operate spray cleaning devices.
  - 3. Simulate fire conditions inside chute to verify sprinkler and detector operation.

### **3.04 CLEANING**

- A. After completion of enclosing walls, clean exposed facility chute components; do not remove testing agency labels.

**END OF SECTION**



# SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Mechanical sleeve seals.
  - 3. Sleeves.
  - 4. Escutcheons.
  - 5. Grout.
  - 6. Fire-suppression equipment and piping demolition.
  - 7. Equipment installation requirements common to equipment sections.
  - 8. Painting and finishing.
  - 9. Supports and anchorages.

### 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. CPVC: Chlorinated polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### **1.04 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Mechanical sleeve seals.
  - 2. Escutcheons.

#### **1.05 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.07 COORDINATION**

- A. Coordinate mechanical equipment installation with other building components. Mechanical contractor will be required to pay for all required openings not shown on Architectural or Structural drawings. Mechanical contractor shall pay the Architect/Engineer fees to design openings.
- B. Mechanical contractor to coordinate installation requirements and construction schedules to install mechanical equipment in new or existing facilities. The mechanical contractor will not be eligible for any additional monetary compensation due to the need to disassemble and reassemble mechanical equipment due to not meeting construction schedules or coordinating with existing conditions.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- E. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 - PRODUCTS**

### **2.01 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.02 JOINING MATERIALS**

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

### **2.03 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM or 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 or Stainless steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### **2.04 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  1. Underdeck Clamp: Clamping ring with set screws.

#### **2.05 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

#### **2.06 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.01 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.02 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.03 PAINTING**

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.04 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### **3.05 GROUTING**

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 210500



## SECTION 21 13 13 - SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
1. Pipes, fittings, and specialties.
  2. Fire-protection valves.
  3. Fire-department connections.
  4. Sprinkler specialty pipe fittings.
  5. Sprinklers.
  6. Alarm devices.
  7. Pressure gages.
- B. Related Sections:
1. Division 01 Section Project Management and Coordination for requirements related to each sub contractor's responsibility to **complete coordination drawings and submit**.
  2. Division 7 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items
  3. Division 21 Section "Common Work Results For Fire Suppression".

#### 1.02 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.
- B. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.
1. Provide dry sprinkler heads in locations that have potential of freezing: screen porch, etc.
  2. Provide complete Dry-pipe system for entire attic space.

#### 1.03 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Coordinate with local authorities and perform fire-hydrant flow test.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Determine Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  2. Sprinkler Occupancy Hazard Classifications: See architectural for specific classification, NFPA for recommended hazard classifications and coordinate with local fire marshal for additional local requirements and classifications.

#### **1.04 SUBMITTALS**

- A. This contractor shall submit sprinkler drawings to architect prior to submittal to city for review and after.
- B. This contractor shall obtain approved shop drawings from Engineer and Architect and incorporate comments and changes prior to fabrication and installation of fire sprinkler system. Any costs created from field changes or corrections due to not incorporating Engineer and Architect comments shall be the responsibility of this contractor.
- C. Product Data: For each type of product indicated.
- D. Shop Drawings: For wet-pipe & dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- E. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
- G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- H. Operation and maintenance data.

#### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- 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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."

### **PART 2 - PRODUCTS**

#### **2.01 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

## 2.02 STEEL PIPE AND FITTINGS

- A. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- B. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- C. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, lightwall, with plain ends.
- D. Galvanized- and Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized and Uncoated, Steel Couplings: ASTM A 865, threaded.
- F. Galvanized and Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
  - 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. Corcoran Piping System Co.
    - b. National Fittings, Inc.
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- K. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
  - 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. Victaulic Company.

## 2.03 CPVC PIPING

- A. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

## **2.04 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
  - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
  - 1. CPVC solvent cement shall have a VOC content of 490 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).
- D. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## **2.05 LISTED FIRE-PROTECTION VALVES**

- A. General Requirements:
  - 1. Valves shall be UL listed or FM approved.
  - 2. Minimum Pressure Rating: 175 psig.
- B. Check Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Globe Fire Sprinkler Corporation.
    - e. Milwaukee Valve Company.
    - f. Mueller Co.; Water Products Division.
    - g. NIBCO INC.
    - h. Reliable Automatic Sprinkler Co., Inc.
    - i. Tyco Fire & Building Products LP.
    - j. Victaulic Company.
    - k. Viking Corporation.
    - l. Watts Water Technologies, Inc.
  - 2. Standard: UL 312.
  - 3. Pressure Rating: 250 psig minimum.
  - 4. Type: Swing check.
  - 5. Body Material: Cast iron.
  - 6. End Connections: Flanged or grooved.
- C. Bronze OS&Y Gate Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Crane Co.; Crane Valve Group; Stockham Division.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. United Brass Works, Inc.
  - 2. Standard: UL 262.

3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Milwaukee Valve Company.
  - e. Mueller Co.; Water Products Division.
  - f. NIBCO INC.
  - g. Tyco Fire & Building Products LP.
  - h. United Brass Works, Inc.
  - i. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Global Safety Products, Inc.
  - b. Milwaukee Valve Company.
  - c. NIBCO INC.
  - d. Tyco Fire & Building Products LP.
  - e. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, supervisory switch or visual indicating device.

**2.06 TRIM AND DRAIN VALVES**

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Milwaukee Valve Company.
- b. NIBCO INC.
- c. Tyco Fire & Building Products LP.
- d. Victaulic Company.
- e. Watts Water Technologies, Inc.

## 2.07 SPECIALTY VALVES

- A. General Requirements:
  - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body Material: Cast or ductile iron.
  - 4. Size: Same as connected piping.
  - 5. End Connections: Flanged or grooved.
  
- B. Alarm Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  - 2. Standard: UL 193.
  - 3. Design: For horizontal or vertical installation.
  - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
  - 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
  - 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
  
- C. Automatic (Ball Drip) Drain Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
  - 2. Standard: UL 1726.
  - 3. Pressure Rating: 175 psig minimum.
  - 4. Type: Automatic draining, ball check.
  - 5. Size: NPS 3/4.
  - 6. End Connections: Threaded.
  
- D. Dry-Pipe Valves:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  - 2. Standard: UL 260
  - 3. Design: Differential-pressure type.

4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air Compressor:
  - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Gast Manufacturing Inc.
    - 2) General Air Products, Inc,
    - 3) Viking Corporation.
  - b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  - c. Motor Horsepower: Fractional.
  - d. Power: 120-V ac, 60 Hz, single phase.

## 2.08 FIRE-DEPARTMENT CONNECTIONS

- A. Flush-Type, Fire-Department Connection:
- B. Manufacturer: Subject to compliance with requirements, provide **Elkhart #166** or comparable product by one of the following: Verify inlet quantity with local fire marshal, verify finish with architect.
  - a. Elkhart Brass Mfg. Company, Inc.
  - b. Guardian Fire Equipment, Inc.
  - c. Potter Roemer.
  2. Standard: UL 405.
  3. Type: Flush, for wall mounting.
  4. Pressure Rating: 175 psig minimum.
  5. Body Material: Corrosion-resistant metal.
  6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
  7. Caps: Brass, lugged type, with gasket and chain.
  8. Escutcheon Plate: Rectangular, brass, wall type.
  9. Outlet: With pipe threads.
  10. Body Style: Horizontal.
  11. Number of Inlets: Two.
  12. Outlet Location: Bottom or Top. Verify location with application.
  1. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
  2. Finish: Polished brass.
  3. Outlet Size: NPS 4.

## 2.09 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Tyco Fire & Building Products LP.
    - b. Victaulic Company.
  2. Standard: UL 213.
  3. Pressure Rating: 175 psig minimum.
  4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  5. Type: Mechanical-T and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  8. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Tyco Fire & Building Products LP.
    - b. Victaulic Company.
  2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  3. Pressure Rating: 175 psig minimum.
  4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  5. Size: Same as connected piping.
  6. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkhart Brass Mfg. Company, Inc.
    - b. Fire-End & Croker Corporation.
    - c. Potter Roemer.
  2. Standard: UL 199.
  3. Pressure Rating: 175 psig minimum.
  4. Body Material: Brass.
  5. Size: Same as connected piping.
  6. Inlet: Threaded.
  7. Drain Outlet: Threaded and capped.
  8. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Tyco Fire & Building Products LP.
    - b. Victaulic Company.
    - c. Viking Corporation.
  2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  3. Pressure Rating: 175 psig minimum.
  4. Body Material: Cast- or ductile-iron housing with sight glass.
  5. Size: Same as connected piping.
  6. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CECA, LLC.
    - b. Corcoran Piping System Co.
    - c. Merit Manufacturing; a division of Anvil International, Inc.
  2. Standard: UL 1474.
  3. Pressure Rating: 250 psig minimum.



4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fivalco Inc.
  - b. FlexHead Industries, Inc.
  - c. Gateway Tubing, Inc.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

**2.010** SPRINKLERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.
5. Reliable

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory," listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. White
3. Bronze.
4. Corrosion-resistant paint.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mount (semi-recessed): White steel, one piece.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
3. Ceiling Mounting (Concealed Heads): Verify custom color with Architect in areas where ceiling are painted non-white.

- F. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. McMaster-Carr, Model 6411T25 red in color.
    - b. Swift Fire Protection Inc., model ACGH2RO50 red in color.
  2. Standard: UL 199.
  3. Type: Heavy duty 2 piece wire cage with screw fastening device for attaching to sprinkler head.

## **2.011 ALARM DEVICES**

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Victaulic Company.
    - b. Viking Corporation.
  2. Standard: UL 753.
  3. Type: Mechanically operated, with Pelton wheel.
  4. Alarm Gong: Cast aluminum with red-enamel factory finish.
  5. Size: 10-inch diameter.
  6. Components: Shaft length, bearings, and sleeve to suit wall construction.
  7. Inlet: NPS 3/4.
  8. Outlet: NPS 1 drain connection.
- C. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ADT Security Services, Inc.
    - b. McDonnell & Miller; ITT Industries.
    - c. Potter Electric Signal Company.
    - d. System Sensor; a Honeywell company.
    - e. Viking Corporation.
    - f. Watts Industries (Canada) Inc.
  2. Standard: UL 346.
  3. Water-Flow Detector: Electrically supervised.
  4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  5. Type: Paddle operated.
  6. Pressure Rating: 250 psig.
  7. Design Installation: Horizontal or vertical.
- D. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Fire-Lite Alarms, Inc.; a Honeywell company.
    - b. Kennedy Valve; a division of McWane, Inc.
    - c. Potter Electric Signal Company.
    - d. System Sensor; a Honeywell company.
  2. Standard: UL 346.
  3. Type: Electrically supervised.

4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

**2.012 PRESSURE GAGES**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. AMETEK; U.S. Gauge Division.
  3. Ashcroft, Inc.
  4. Brecco Corporation.
  5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

**PART 3 - EXECUTION**

**3.01 SERVICE-ENTRANCE PIPING**

- A. Connect sprinkler piping to water-service piping for service entrance to building.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

**3.02 PIPING INSTALLATION**

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.

- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.
- N. Drain dry-pipe sprinkler piping.
- O. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices and air compressors.

### **3.03 JOINT CONSTRUCTION**

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

### **3.04 VALVE AND SPECIALTIES INSTALLATION**

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Specialty Valves:
  1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
  2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
  3. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    - a. Install air compressor and compressed-air supply piping.

### **3.05 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels. Coordinate sprinkler head placement with light fixture locations for symmetrical sprinkler head pattern.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### **3.06 FIRE-DEPARTMENT CONNECTION INSTALLATION**

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### **3.07 IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### **3.08 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems 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. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Start and run excess-pressure pumps.
  - 6. Coordinate with fire-alarm tests. Operate as required.
  - 7. Coordinate with fire-pump tests. Operate as required.
  - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.09 CLEANING**

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.010 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
  - 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  - 3. Standard-weight or Schedule 30, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
  - 4. Standard-weight or Schedule 30, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
  - 5. Standard-weight or Schedule 30, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 6. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 7. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
  - 8. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 9. Thinwall black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
  - 10. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.
  - 11. Schedule 5 steel pipe; steel pressure-seal fittings; and pressure-sealed joints.
  - 12. CPVC, SDR 11
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
  - 1. Standard-weight or Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  - 3. Standard-weight or Schedule 30, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 4. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 5. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
  - 6. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 7. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.
- E. Dry-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
  - 1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  - 2. Standard-weight Schedule 30 or thinwall, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.

3. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  4. CPVC and Schedule 10 piping as allowed per NFPA.
- F. Dry-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  3. CPVC and Schedule 10 piping as allowed per NFPA.

### **3.011 SPRINKLER SCHEDULE**

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
  2. Rooms with Suspended Ceilings: Semi-recessed sprinklers.
  3. Rooms with Gyp board Ceilings: Fully-recessed sprinklers.
  4. Wall Mounting: Sidewall sprinklers.
  5. Spaces Subject to Freezing: Sidewall, dry sprinklers;
  6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Semi-recessed Sprinklers: White, with white escutcheon.
  2. Fully-recessed Sprinklers: To match ceiling color, provide color chart to Architect for selection.
  3. Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION





# SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Painting and finishing.
  - 10. Supports and anchorages.

### 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### **1.04 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.06 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

### **PART 2 - PRODUCTS**

#### **2.01 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## **2.02 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## **2.03 TRANSITION FITTINGS**

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
  - 2. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
  - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

#### **2.04 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

#### **2.05 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM or 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 or Stainless steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### **2.06 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## **2.07 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## **2.08 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.01 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.

- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.02 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.



- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### **3.03 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.05 PAINTING**

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.07 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### **3.08 GROUTING**

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

# SECTION 220519 - 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. Thermometers.
  - 2. Gages.
  - 3. Test plugs.
- B. Related Sections:
  - 1. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
  - 2. Division 22 Section "Natural Gas Piping"

### 1.03 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

## PART 2 - PRODUCTS

### 2.01 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Case: Die-cast aluminum or brass 9 inches (229 mm) long.
- B. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.
- C. Tube Background: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- D. Window: Glass or plastic
- E. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device

- F. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- G. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

## **2.02 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS**

- A. Case: Dry type, drawn steel or cast aluminum 4-1/2-inch (114-mm) diameter.
- B. Element: Bourdon tube or other type of pressure element.
- C. Movement: Mechanical, connecting element and pointer.
- D. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Pointer: Red metal.
- F. Window: Glass or plastic
- G. Ring: Metal, Brass or Stainless steel
- H. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device
- I. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.
- J. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

## **2.03 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS**

- A. Case: Dry type, drawn steel or cast aluminum 4-1/2-inch (114-mm) for panel mounting.
- B. Element: Bourdon tube or other type of pressure element.
- C. Movement: Mechanical, connecting element and pointer.
- D. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Pointer: Red metal.
- F. Window: Glass or plastic.
- G. Ring: Metal, Brass or Stainless steel.
- H. Connector: Bottom or Back union type.

- I. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.
- J. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

#### **2.04 BIMETALLIC-ACTUATED DIAL THERMOMETERS**

- A. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
- B. Case: Dry type, stainless steel with 3-inch (76-mm) diameter.
- C. Element: Bimetal coil.
- D. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
- E. Pointer: Red metal.
- F. Window: Glass or plastic
- G. Ring: Stainless steel.
- H. Connector: Adjustable angle type.
- I. Stem: Metal, for thermowell installation and of length to suit installation.
- J. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

#### **2.05 THERMOWELLS**

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

#### **2.06 PRESSURE GAGES**

- A. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
  - 1. Case: Dry type, drawn steel or cast aluminum 4-1/2-inch (114-mm) diameter.
  - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
  - 3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
  - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
  - 6. Pointer: Red metal.
  - 7. Window: Glass or plastic
  - 8. Ring: Metal, Brass or Stainless steel

9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
11. Range for Fluids under Pressure: Two times operating pressure.

B. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Dry type, drawn steel or cast aluminum, 4-1/2-inch (114-mm) diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass or plastic
8. Ring: Meta, Brass or Stainless steel
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

## 2.07 TEST PLUGS

- A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- B. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C)
- C. Core Inserts: One or two self-sealing rubber valves.
  1. Insert material for water service at 20 to 200 deg F (minus 7 to plus 93 deg C) shall be CR.
  2. Insert material for water service at minus 30 to plus 275 deg F (minus 35 to plus 136 deg C) shall be EPDM.
- D. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
  1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be 0 to 200 psig (0 to 1380 kPa)
  2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F (minus 4 to plus 52 deg C)

3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be [0 to 220 deg F (minus 18 to plus 104 deg C)]
4. Carrying case shall have formed instrument padding.

## **PART 3 - EXECUTION**

### **3.01 THERMOMETER APPLICATIONS**

- A. Install liquid-in-glass thermometers in the outlet of each domestic, hot-water storage tank.
- B. Install dry-case-type, bimetallic-actuated dial thermometers at discharge of each pump.
- C. Provide the following temperature ranges for thermometers:
  1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions (Minus 1 to plus 82 deg C, with 1-degree scale divisions)
  2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions)

### **3.02 METER AND GAGE INSTALLATION, GENERAL**

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.
- C. Installation of piping accessories and piping specialties shall be accomplished with the use of outlet fittings, tees or thread-o-lets.
- D. Coordinate the installation requirements for the water meter with the utility company.
- E. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- F. Install dry-type pressure gages in the following locations:
  1. Discharge of each pressure-reducing valve.
  2. Building water-service entrance.
- G. Install liquid-filled-type pressure gages at suction and discharge of each pump.
  1. Glycerin filled gages shall be used for water temperatures of 150 deg F and less.
  2. Silicone filled gages shall be used for water temperatures greater than 150 deg, F.
- H. Install pressure-gage needle valve and snubber in piping to pressure gages.

### **3.03 ROUGHING IN FOR WATER METERS**

- A. Install rough-in piping and specialties for water meter installation according to utility's instructions and requirements.
- B. Rough in for tenant water meters on each hot and cold water tap to each individual tenant according to the manufacturer's recommendations. Meters and monitoring provided by Utility Management Solutions, (952)934-4346, [www.utilitymanage.com](http://www.utilitymanage.com).

### **3.04 INSTALLATIONS**

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install in locations as detailed on the drawings.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
  - 1. Install with socket extending to center of pipe.
  - 2. Fill sockets with oil or graphite and secure caps.
- D. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
  - 1. Install with stem extending to center of pipe.
  - 2. Fill wells with oil or graphite and secure caps.
- E. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- F. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.
- G. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- H. Install remote-mounting pressure gages on panel.
- I. Install needle-valve and snubber fitting in piping for each pressure gage.
- J. Install test plugs in tees in piping.
- K. Install permanent indicators on walls or brackets in accessible and readable positions.
- L. Install connection fittings for attachment to portable indicators in accessible locations.
- M. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- N. Adjust faces of thermometers and gages to proper angle for best visibility.



**3.05 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
  - 1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.

**3.06 ADJUSTING AND CLEANING**

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 220519



## **SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Bronze angle valves.
  - 2. Bronze ball valves.
  - 3. Iron ball valves.
  - 4. Iron, single-flange butterfly valves.
  - 5. Bronze lift check valves.
  - 6. Bronze swing check valves.
  - 7. Iron swing check valves.
  - 8. Iron swing check valves with closure control.
  - 9. Bronze globe valves.
  - 10. Iron globe valves.
- B. Related Sections:
  - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
  - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
  - 3. Division 23 piping Sections for specialty valves applicable to those Sections only.

#### **1.03 DEFINITIONS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### **1.04 QUALITY ASSURANCE**

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### **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 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**

#### **2.01 GENERAL REQUIREMENTS FOR VALVES**

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
  - 2. Gear Drive: For quarter-turn valves NPS 8 (DN 200) and larger.
  - 3. Handwheel: For valves other than quarter-turn types.
  - 4. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
  - 5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- 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.

## 2.02 BRONZE ANGLE VALVES

A. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

## 2.03 BRONZE BALL VALVES

A. 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:
  - 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.

## **2.04 IRON BALL VALVES**

### **A. Class 125, Iron Ball Valves:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

## **2.05 IRON, SINGLE-FLANGE BUTTERFLY VALVES**

### **A. 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:
  - 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 Corporation.
  - 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, Inc.
- 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.

B. 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:

- 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 Corporation.
- 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, Inc.
- 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.

## **2.06 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:
  - 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.

## **2.07 BRONZE SWING CHECK VALVES**

### **A. Class 150, Bronze Swing Check Valves with Bronze Disc:**

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



## **2.08 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:
  - 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. 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.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.

## **2.09 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:
  - a. NIBCO INC.
2. 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.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.
  - h. Closure Control: Factory-installed, exterior lever and spring.

## **2.010 BRONZE GLOBE VALVES**

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

## **2.011 IRON GLOBE VALVES**

- A. Class 125, Iron Globe Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

## **2.012 CHAINWHEELS**

- A. 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 and butterfly valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
  - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

## **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 chainwheels on operators for 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. Lift Check Valves: With stem upright and plumb.

### **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. Shutoff Service: Ball, butterfly, or plug valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe or angle, ball, or butterfly valves.
  - 4. Pump-Discharge Check Valves:
    - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-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.
  - 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

### **3.05 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. Bronze Angle Valves: Class 150, bronze disc.
  - 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
  - 4. Bronze Swing Check Valves: Class 150, bronze disc.
  - 5. Bronze Globe Valves: Class 150, 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: Class 150.
  - 3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
  - 4. Iron Swing Check Valves: Class 125 metal seats.

5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
6. Iron Globe Valves: Class 125.

### **3.06 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE**

#### **A. Pipe NPS 4 (DN 100) and Smaller:**

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
4. Bronze Swing Check Valves: Class 150, bronze disc.
5. Bronze Globe Valves: Class 150, nonmetallic disc.

END OF SECTION 220523



# SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fiberglass pipe hangers.
  - 4. Metal framing systems.
  - 5. Fiberglass strut systems.
  - 6. Thermal-hanger shield inserts.
  - 7. Fastener systems.
  - 8. Pipe stands.
  - 9. Pipe positioning systems.
  - 10. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

### 1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

### 1.04 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## **1.05 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel."

## **PART 2 - PRODUCTS**

### **2.01 STEEL PIPE HANGERS AND SUPPORTS**

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

### **2.02 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

### **2.03 FIBERGLASS PIPE HANGERS**

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.

### **2.04 METAL FRAMING SYSTEMS**

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

### **2.05 FIBERGLASS STRUT SYSTEMS**

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.



## **2.06 THERMAL-HANGER SHIELD INSERTS**

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (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 steel, 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 STAND FABRICATION**

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 1. Base: Plastic
  - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 1. Bases: One or more plastic.

2. Vertical Members: Two or more protective-coated-steel channels.
  3. Horizontal Member: Protective-coated-steel channel.
  4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

## **2.09 PIPE POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

## **2.010 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## **2.011 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

# **PART 3 - EXECUTION**

## **3.01 HANGER AND SUPPORT APPLICATIONS**

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- F. 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 non-insulated 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 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), 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 24 (DN 20 to DN 600), 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 non-insulated stationary pipes, NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated 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 non-insulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated 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.
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 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 2 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 20 (DN 65 to DN 500), 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.

G. 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 20 (DN 20 to DN 500).

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. 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.
- I. 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.
- J. 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.
- K. 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 absorb 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 absorb 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 absorb 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system 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.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### **3.02 HANGER AND SUPPORT INSTALLATION**

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

- 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-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (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.
- O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

Q. Insulated Piping: Comply with the following:

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 according to 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 inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.03 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.04 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 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### **3.05 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).

### **3.06 PAINTING**

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529



# SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Valve tags.
  - 5. Warning tags.

### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Valve numbering scheme.
- C. Valve Schedules: For each piping system to include in maintenance manuals.

### 1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 - PRODUCTS**

### **2.01 EQUIPMENT LABELS**

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032-inch (0.8-mm), Stainless steel, 0.025-inch (0.64-mm) or anodized aluminum, 0.032-inch (0.8-mm)] minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
  - 3. 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-fourths the size of principal lettering.
  - 4. Fasteners: Stainless-steel self-tapping screws.
  - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

### **2.02 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black
- C. Background Color: 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

### **2.03 PIPE LABELS**

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

### **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 or beaded chain
- 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. Warning Tags: 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
  - 2. Fasteners: Brass grommet and wire
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Yellow background with black lettering.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.02 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.03 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting"
- B. 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. Pipe Label Color Schedule:
  - 1. Low-Pressure, Compressed-Air Piping:
    - a. Background Color: Blue.
    - b. Letter Color: White.
  - 2. Natural Piping:
    - a. Background Color: Yellow.
    - b. Letter Color: Black.
  - 3. Domestic Water Piping:
    - a. Background Color: Green
    - b. Letter Color: White
  - 4. Sanitary Waste and Vent, and Storm Drainage Piping:

- a. Background Color: Green
- b. Letter Color: White

### **3.04 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), round.
    - b. Hot Water: 1-1/2 inches (38 mm), round.
    - c. Natural Gas: 1-1/2 inches (38 mm), round.
    - d. Low-Pressure Compressed Air: 1-1/2 inches (38 mm), round.
    - e. High-Pressure Compressed Air: 1-1/2 inches (38 mm), round.
  - 2. Valve-Tag Color:
    - a. Cold Water: Green.
    - b. Hot Water: Green.
    - c. Low-Pressure Compressed Air: Green.
    - d. Natural gas: Yellow
  - 3. Letter Color:
    - a. Cold Water: White.
    - b. Hot Water: White.
    - c. Low-Pressure Compressed Air: White.
    - d. Natural Gas: Black

### **3.05 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553



## **SECTION 22 07 00 - PLUMBING INSULATION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Mineral fiber.
  - 2. Insulating cements.
  - 3. Adhesives.
  - 4. Sealants.
  - 5. Factory-applied jackets.
  - 6. Tapes.
  - 7. Securements.
  - 8. Corner angles.
  
- B. Related Sections:
  - 1. Division 7 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items
  - 2. Division 23 Section "HVAC Insulation."

#### **1.2 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
  
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

### **PART 2 - PRODUCTS**

#### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
  
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
  
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following (Substitutions: See Section 01 60 00 – Product Requirements):
    - 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.
    - f. Johns Mansville
  - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. 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. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following (Substitutions: See Section 01 60 00 – Product Requirements):
    - 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.
    - f. Johns Mansville

## 2.2 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, 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. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:



- a. Childers Products, Division of ITW; CP-82.
  - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
  - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
  - d. Marathon Industries, Inc.; 225.
  - e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, 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. PVC Jacket Adhesive: Compatible with PVC jacket.
1. **Products:** Subject to compliance with requirements, provide one of 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."

## 2.3 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.
  4. Color: White or gray.
- B. FSK Jacket Flashing Sealants:
1. **Products:** Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-76-8.
    - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Vimasco Corporation; 750.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F.
  5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. **Products:** Subject to compliance with requirements, provide one of the following (Substitutions: See Section 01 60 00 – Product Requirements):
    - 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."

## **2.4 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## **2.5 TAPES**

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

## **2.6 SECUREMENTS**

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products; Bands.
    - b. PABCO Metals Corporation; Bands.
    - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
  1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      - 2) GEMCO; Perforated Base.
      - 3) Midwest Fasteners, Inc.; Spindle.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. 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. Products: Subject to compliance with requirements, provide one of the following:
      - 1) GEMCO; Nylon Hangers.
      - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
    - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      - 2) GEMCO; Press and Peel.
      - 3) Midwest Fasteners, Inc.; Self Stick.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive-backed base with a peel-off protective cover.
  4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; RC-150.
      - 2) GEMCO; R-150.
      - 3) Midwest Fasteners, Inc.; WA-150.
      - 4) Nelson Stud Welding; Speed Clips.
    - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) GEMCO.
      - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire.
    - b. Childers Products.
    - c. PABCO Metals Corporation.
    - d. RPR Products, Inc.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- 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 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.

### **3.3 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.

- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Division 07 Section "Penetration 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 Division 07 Section "Penetration Firestopping."

### **3.4 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION**

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  - 3. Protect exposed corners with secured corner angles.
  - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  - 7. Stagger joints between insulation layers at least 3 inches.
  - 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  - 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  - 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

### 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, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on

- each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.6 MINERAL-FIBER INSULATION INSTALLATION**

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.



### **3.7 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
  - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.8 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.

**PART 4 - Table 1: Plumbing Equipment and Piping Insulation Applications**

Plumbing Piping Systems	Insulation Types (1)	Density (lbs./cu. ft.)	Insulation Thickness (4)	Vapor Barrier Requirements (2)	Jacket Types (3)
Domestic cold water, up to 1-1/2"	GF	2.5	1/2 inch	Yes	AP
Domestic cold water, 1-1/2" and larger	GF	2.5	1 inch	Yes	AP
Domestic hot water and circulating hot water up to 1-1/2" and water temperature below 160°F	GF	2.5	1 inch	None	AP
Domestic hot water, circulating hot water and tanks over 1-1/2", water temp. below 160°F.	GF	2.5	1-1/2 inch	None	AP
Stormwater and overflow	GF	2.5	1 inch	Yes	AP
Roof drain and overflow drain bodies	GF	2.5	1 inch	Yes	AP
<p>(1) Key to Insulation Materials:            GF = Glass or mineral fiber            CG = Cellular glass            FE = Flexible elastomeric foam            PF = Closed cell phenolic foam            CS = Calcium silicate            HTGF= high temperature glass fiber</p> <p>(2) Key to Vapor Barrier Requirements:            Yes = Required            None = Not required            SJ = continuous sealed joints required</p> <p>(3) Key to Jacket Requirements:            AP = All purpose foil, scrim, kraft paper jacket (white).            FSK = Foil, scrim, kraft paper jacket with foil finish.            PVC = PVC jacket.            AL = Aluminum jacket            SS = Stainless steel jacket            GC = Canvas or glass cloth</p> <p>(4) For piping smaller than 1½ inch (38 mm) and located in partitions within <i>conditioned spaces</i>, reduction of these thicknesses by 1 inch (25 mm) shall be permitted, but not to a thickness less than 1 inch (25 mm).</p>					

**END OF SECTION**

## **SECTION 22 11 16 - DOMESTIC WATER PIPING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
  - 2. Specialty valves.
  - 3. Flexible connectors.
  - 4. Water meters.
  
- B. Related Section:
  - 1. Division 7 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items

#### **1.02 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
  
- B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
  
- C. Comply with NSF 61 for potable domestic water piping and components.
  
- D. All piping shall be tested for working pressure of 150 psi minimum and temperature of 210 degree Fahrenheit, as required by Minnesota code.

### **PART 2 - PRODUCTS**

#### **2.01 PIPING MATERIALS**

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

#### **2.02 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
  - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
  - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
  - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
  - 5. Copper Pressure-Seal-Joint Fittings:
    - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    - b. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
  - 6. Copper Push-on-Joint Fittings:

- a. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
  - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  - 2. Copper Pressure-Seal-Joint Fittings:
    - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
    - b. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

### **2.03 DUCTILE-IRON PIPE AND FITTINGS**

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
  - 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
    - a. Gaskets: AWWA C111, rubber.
  - 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
    - a. Gaskets: AWWA C111, rubber.

### **2.04 CPVC PIPING**

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40.
  - 1. CPVC Socket Fittings: ASTM F 438 for Schedule 40.
  - 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.
- D. CPVC piping and fittings shall also be compliant with ANSI 119.1, ANSI 119.2, NSF14, FHA bulletin #76 and CSA-B137.6
- E. System installation must be in accordance with International Association of Plumbing and Mechanical Officials (IAPMO) Installation standard 20-98, however this material may be air tested.

### **2.05 PEX TUBE AND FITTINGS**

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing. System (tubing and fittings) shall be certified by independent third-party certifier.
- B. PEX Tube: ASMT F876, ASTM F877, NSF14 and NSF 61, with certification by independent third-party certifier.
- C. PEX Fittings: ASMT F1807, ASMT F1960, NSF14, NSF 61, 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.
- E. CPVC piping and fittings shall also be compliant with ASMT F876, ASTM F877, NSF14 and NSF 61.

- F. This water distribution system shall be installed by a factory-trained installer in accordance with manufacturers installation instructions. Tubing and fittings must be marked with appropriate ASTM designations by manufacturer.

## **2.06 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
  - 1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## **2.07 SPECIALTY VALVES**

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
- C. CPVC Union Ball Valves:
  - 1. Description:
    - a. Standard: MSS SP-122.
    - b. Pressure Rating: 125 psig at 73 deg F.
    - c. Body Material: CPVC.
    - d. Body Design: Union type.
    - e. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
    - f. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket or Flanged.
    - g. Ball: CPVC; full port.
    - h. Seals: PTFE or EPDM-rubber O-rings.
    - i. Handle: Tee shaped.
- D. CPVC Ball Check Valves:
  - 1. Description:
    - a. Pressure Rating: 125 psig at 73 deg F.
    - b. Body Material: CPVC.
    - c. Body Design: Union-type ball check.
    - d. End Connections for Valves NPS 2 and Smaller: Detachable, socket.

- e. End Connections for Valves NPS 2-1/2 to NPS 4: Detachable, socket or Flanged.
- f. Ball: CPVC.
- g. Seals: EPDM- or FKM-rubber O-rings.

E. CPVC Gate Valves:

- 1. Description:
  - a. Pressure Rating: 125 psig at 73 deg F.
  - b. Body Material: CPVC.
  - c. Body Design: Nonrising stem.
  - d. End Connections for Valves NPS 2 and Smaller: Socket.
  - e. End Connections for Valves NPS 2-1/2 to NPS 4: Socket or Flanged.
  - f. Gate and Stem: Plastic.
  - g. Seals: EPDM rubber.
  - h. Handle: Wheel.

**2.08 TRANSITION FITTINGS**

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.
- C. Plastic-to-Metal Transition Fittings:
  - 1. Description: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.
- D. Plastic-to-Metal Transition Unions:
  - 1. Description: CPVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

**2.09 DIELECTRIC FITTINGS**

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
  - 1. Description:
    - a. Pressure Rating: 150 psig at 180 deg F.
    - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
  - 1. Description:
    - a. Factory-fabricated, bolted, companion-flange assembly.
    - b. Pressure Rating: 150 psig.
    - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Couplings:
  - 1. Description:
    - a. Galvanized-steel coupling.
    - b. Pressure Rating: 300 psig at 225 deg F.
    - c. End Connections: Female threaded.
    - d. Lining: Inert and noncorrosive, thermoplastic.

## **2.010 FLEXIBLE CONNECTORS**

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
  
- B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## **2.011 WATER METERS**

- A. Water meter shall be provided per city/state requirements. Plumbing contractor is responsible for all meter charges.
  
- B. Tenant water meters shall be provided by Utility Management Solutions, (952) 934-4346.

## **PART 3 - EXECUTION**

### **3.01 EARTHWORK**

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### **3.02 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
  
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
  
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
  
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
  
- E. Install shutoff valve immediately upstream of each dielectric fitting.
  
- F. Install domestic water piping level and plumb.
  
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. 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.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping adjacent to equipment and specialties to allow service and maintenance.
- L. Install piping to permit valve servicing.
- M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- R. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- S. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Common Work Results for Plumbing."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

### **3.03 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.



- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. 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.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

#### **3.04 VALVE INSTALLATION**

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
  1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

#### **3.05 TRANSITION FITTING INSTALLATION**

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  1. NPS 1-1/2 and Smaller: Fitting-type coupling.
  2. NPS 2 and Larger: Sleeve-type coupling.

- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### **3.06 DIELECTRIC FITTING INSTALLATION**

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

### **3.07 FLEXIBLE CONNECTOR INSTALLATION**

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

### **3.08 WATER METER INSTALLATION**

- A. Rough-in domestic and irrigation water piping and install water meters according to utility company's requirements. This contractor shall coordinate with local city or utility and provide meters as required and is responsible for all associated costs.
- B. Install water meters according to AWWA M6, utility company's requirements, and the following:
- C. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

### **3.09 TENANT METERING**

- A. Rough-in and install tenant water meters according to manufacturer's requirements. This contractor shall coordinate with Owner and supplier for installation requirements.

### **3.010 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
  - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.

- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 6. NPS 6: 10 feet with 5/8-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
  - 7. NPS 6: 12 feet with 3/4-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
  - 2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
- J. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- K. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### **3.011 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### **3.012 IDENTIFICATION**

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

### **3.013 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Piping Inspections:
  1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
  1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
  6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.014 CLEANING**

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### **3.015 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. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be the following:
  1. Soft copper tube, ASTM B 88, Type K; without joints.
- D. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 6, shall be the following:
  1. Push-on-joint, ductile-iron pipe; standard- or compact- pattern push-on-joint fittings; and gasketed joints.
- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
  1. Soft copper tube, ASTM B 88, Type L; without joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  3. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
  4. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
  5. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.
  6. PEX tube, NPS 2 (DN 50) and smaller; fittings for PEX tube; and crimped joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
  3. CPVC, Schedule 80; socket fittings; and solvent-cemented joints.
  4. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
  5. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.

- H. Aboveground domestic water piping, NPS 5 and NPS 6, shall be the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.

**3.016 VALVE SCHEDULE**

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
  - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  - 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
  - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.
- D. CPVC valves matching piping materials may be used.

END OF SECTION

# SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Flow control valves.
  - 5. Temperature-actuated water mixing valves.
  - 6. Strainers.
  - 7. Outlet boxes.
  - 8. Hose bibs.
  - 9. Wall hydrants.
  - 10. Drain valves.
  - 11. Water hammer arresters.
  - 12. Air vents.
- B. Related Sections include the following:
  - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
  - 2. Division 22 Section "Domestic Water Piping" for water meters.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

## PART 2 - PRODUCTS

### 2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. 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
- B. Hose-Connection Vacuum Breakers:
  - 1. Standard: ASSE 1011 for integral part of the product, ASSE 1052 for hose end and ASSE 1019 for wall hydrant type
  - 2. Body: Bronze, nonremovable, with manual drain.
  - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 4. Finish: 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 1/3 of flow range.
  - 4. Accessories:
    - a. Valves: Ball type, on inlet and outlet.
- D. Spill-Resistant Vacuum Breakers:
  - 1. Standard: ASSE 1056.
  - 2. Operation: Continuous-pressure applications.
  - 3. Accessories:
    - a. Valves: Ball type, on inlet and outlet.



## 2.2 BACKFLOW PREVENTERS

### A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.
4. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
5. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
6. Configuration: Designed for horizontal, straight through flow.
7. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

### B. 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.

### C. Backflow-Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.3 WATER PRESSURE-REDUCING VALVES

### A. Water Regulators

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Size: As required for equipment.
5. Design Flow Rate: Verify with equipment
6. Design Inlet Pressure: As per drawings
7. Design Outlet Pressure Setting: As per drawings

8. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

## 2.4 FLOW CONTROL VALVES

- A. Automatic Flow-Control Valves: Factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:
  1. Gray-iron or brass body, designed for 175 psig (1206 kPa) at 200 deg F (93 deg C) with stainless-steel piston and spring.
  2. Brass or ferrous-metal body, designed for 300 psig (2068 kPa) at 250 deg F (121 deg C) with stainless-steel piston and spring.
  3. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig (2067 kPa) at 250 deg F (121 deg C).
  4. Brass or ferrous-metal body designed for 400 psig (2757 kPa) at 225 deg F (107 deg C) with brass or polyphenylsulfone orifice with elastomeric diaphragm.
  5. The manufacturer, for a period of one year from shipment of valves, shall exchange up to 10 percent of the internal flow cartridges at no charge, if flow changes on coils are made
- B. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
  1. NPS 2 (DN 50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded, or solder-joint ends.
  2. NPS 2 (DN 50) and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
  3. NPS 2-1/2 (DN 65) and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- C. Thermally activated flow control. Body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
  1. Sizes ½ inch through 2 inch shall be rated to 200 PSIG maximum working pressure.
    - a. All shall be standard tapered female pipe thread, NPT.
  2. All shall be rated to 300F (148.9C) maximum working temperature.
  3. All shall be ANSI/AWWA C800 compliant.
  4. All shall be NSF-61 certified with zero lead content for use in all domestic water systems.
  5. Thermal actuator shall be spring operated and self cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.
    - a. Thermal actuator shall be rated for a minimum of 200,000 cycles.
- D. Memory-Stop Balancing Valves, NPS 2 (DN 50) and Smaller: MSS SP-110, ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with standard or full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with memory-stop device.

## 2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

### A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bradley
  - b. Lawler Manufacturing Company, Inc.
  - c. Powers; a Watts Industries Co.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa).
4. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
9. Valve Finish: Rough bronze.
10. Piping Finish: Copper.
11. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.
12. Thermometers: Type - Bimetal thermostat, operation and pressure rating 125 psig minimum or Liquid-filled motor, operation and pressure rating 100 psig minimum.
13. See schedule at end for equipment selection.

## 2.6 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 complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded connections for NPS 2 (DN 50) and smaller; flanged connections 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: 0.047 inch (1.2 mm)
  - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.062 inch (1.57 mm)
  - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm)
6. Drain: Factory-installed, hose-end drain valve.

## 2.7 OUTLET BOXES

- A. Icemaker Outlet Boxes (also for kitchen equipment outlet boxes):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn Engineering Company.
    - b. IPS Corporation.
    - c. LSP Products Group, Inc.
    - d. Oatey.
    - e. Plastic Oddities; a division of Diverse Corporate Technologies.
  2. Mounting: Recessed.
  3. Material and Finish: Enameled-steel or epoxy-painted-steel or stainless steel box and faceplate.
  4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 (DN 15) or smaller copper tube outlet.
  5. Supply Shutoff Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.
  6. Provide vacuum breaker on supply line if equipment connected to outlet box has a submerged inlet if required by the local plumbing code.

## 2.8 HOSE BIBBS

- A. Hose Bibbs :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company.
    - b. MIFAB, Inc.
    - c. Prier Products, Inc.
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - e. Tyler Pipe; Wade Div.
    - f. Watts Drainage Products Inc.
    - g. Woodford Manufacturing Company.
  2. Standard: ASME A112.18.1 for sediment faucets.
  3. Body Material: Bronze.
  4. Seat: Bronze, replaceable.
  5. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
  6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
  7. Pressure Rating: 125 psig (860 kPa).
  8. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
  9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
  10. Finish for Service Areas: Rough bronze
  11. Finish for Finished Rooms: Chrome or nickel plated.
  12. Operation for Equipment Rooms: Wheel handle or operating key.
  13. Operation for Service Areas: Wheel handle
  14. Operation for Finished Rooms: Operating key.
  15. Include operating key with each operating-key hose bibb.

16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## **2.9 WALL HYDRANTS**

### **A. Nonfreeze Wall Hydrants, Key Locked:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Woodford Manufacturing Company.
2. Standard: ASME A112.21.3M for concealed exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with hinged, loose key locking, cover.
9. Box and Cover Finish: Rough Brass.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Rough Brass.
12. Operating Keys(s): Two with each wall hydrant.

## **2.10 DRAIN VALVES**

### **A. Ball-Valve-Type, Hose-End Drain Valves:**

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

## 2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. PPP Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products Inc.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 2.12 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 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 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.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- E. Install flow balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install water hammer arresters in water piping according to PDI-WH 201.
- J. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 LABELING AND IDENTIFYING**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Reduced-pressure-principle backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Autoflow balancing valves.
  - 5. Thermostatic, water mixing valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and prepare test reports:
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### **3.5 ADJUSTING**

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

### **3.6 THERMOSTATIC MIXING VALVE SCHEDULE**

- A. TMV-1, Serves Building domestic hot water
  - 1. Manufacturer: Lawler
  - 2. Model: 805



3. Trim:
  - a. Dial thermometers on inlets.
  - b. Inlet check valves.

END OF SECTION 221119



# SECTION 221316 - SANITARY WASTE AND VENT PIPING

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.
  - 3. Encasement for underground metal piping.

### 1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

### 1.04 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. Sanitary Sewer, Force-Main Piping: 100 psig (690 kPa)

### 1.05 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

## **PART 2 - PRODUCTS**

### **2.01 PIPING MATERIALS**

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

### **2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

### **2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
  - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
  - 2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

### **2.04 STAINLESS-STEEL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
- B. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.
  - 1. Material: EPDM, unless NBR is indicated.

### **2.05 COPPER TUBE AND FITTINGS**

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
  - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.22, wrought-copper, solder-joint fittings.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. 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.

## **2.06 PVC PIPE AND FITTINGS**

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
  1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
  1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.
  1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

## **2.07 SPECIAL PIPE FITTINGS**

- A. Flexible, Non-pressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
  1. Sleeve Materials:
    - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Non-pressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
  1. Center-Sleeve Material: Manufacturer's standard.
  2. Gasket Material: Natural or synthetic rubber.
  3. Metal Component Finish: Corrosion-resistant coating or material.
- D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

- E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

## **2.08 ENCASEMENT FOR UNDERGROUND METAL PIPING**

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch (0.10-mm) or LLDPE film of 0.008-inch (0.20-mm) minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

## **PART 3 - EXECUTION**

### **3.01 EXCAVATION**

- A. Refer to Division 31 Section "Earthwork, Subgrade, and Subbase" for excavating, trenching, and backfilling.

### **3.02 PIPING APPLICATIONS**

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (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; Heavy-duty, shielded, stainless-steel couplings.
  - 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
  - 4. Copper DWV tube, copper drainage fittings, and soldered joints.
- 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; Heavy-duty, shielded, stainless-steel couplings.
  - 3. Steel pipe, drainage fittings, and threaded joints.
- 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; Heavy-duty, shielded, stainless-steel couplings.
  - 3. Stainless-steel pipe and fittings gaskets, and gasketed joints.
  - 4. 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 L (Type B); copper pressure fittings; and soldered joints.
  
- 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; Heavy-duty, shielded, stainless-steel couplings.
  
- F. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be one of the following:
  - 1. Hard copper tube, Type L (Type B) or Type M (Type C); copper pressure fittings; and soldered joints.
  - 2. Steel pipe, pressure fittings, and threaded joints.
  
- G. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be any of the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. Hubless cast-iron soil pipe and fittings; Heavy-duty, shielded, stainless-steel couplings.
  - 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
  - 4. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
    - a. Installation must comply with ASTM D2321.
  - 5. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
    - a. Installation must comply with ASTM D2321.
  
- H. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:
  - 1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  - 2. Hubless cast-iron soil pipe and fittings; Heavy-duty, shielded, stainless-steel couplings.
  - 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
  - 4. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
    - a. Installation must comply with ASTM D2321
  - 5. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints
    - a. Installation must comply with ASTM D2321
  
- I. Underground sanitary-sewage force mains NPS 4 (DN 100) and smaller shall be one of the following:
  - 1. Hard copper tube, Type L (Type B); wrought-copper pressure fittings; and soldered joints.
  - 2. Steel pipe, pressure fittings, and threaded joints.
    - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
  - 3. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical joints.
    - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

4. Push-on-joint, ductile-iron pipe; push-on-joint ductile-iron fittings; gaskets; and gasketed joints.
  - a. Include grooved-joint system fittings and couplings and grooved joints where indicated.
5. Pressure pipe couplings, if dissimilar pipe materials or piping with small difference in OD must be joined.

### **3.03 PIPING INSTALLATION**

- A. Sanitary sewer piping outside the building is specified in Division 33 Section "Sanitary Sewerage."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.
- F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the 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.
- G. 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.
- H. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
  1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- I. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- J. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- K. 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.
- L. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks



if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

- M. 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.
- N. 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 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.
- O. 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. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
  - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- Q. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- R. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### **3.04 JOINT CONSTRUCTION**

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### **3.05 VALVE INSTALLATION**

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
  - 1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
  - 2. 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.

### **3.06 CLEANOUT INSTALLATION**

- A. Install cleanouts in aboveground and underground 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 (30m) for larger piping.
  - 4. Locate at base of each vertical soil and waste stack. Add wall cleanout as needed.

### **3.07 HANGER AND SUPPORT INSTALLATION**

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet (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. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.

- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters (unless noted otherwise):
  - 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 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
  - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters (unless noted otherwise):
  - 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.
- H. Install supports for vertical stainless-steel piping every 10 feet (3 m).
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters (unless noted otherwise):
  - 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 to NPS 5 (DN 80 to 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.
- J. Install supports for vertical copper tubing every 10 feet (3 m).
- K. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).
- L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **3.08 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. 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 or storm manhole.
  2. To sump pump and route to exterior of building.

### **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. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- 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**

- 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.

**3.011 PROTECTION**

- A. Exposed PVC Piping: Protect from sunlight with two coats of water-based latex paint.

END OF SECTION 221316



# SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
  - 1. Cleanouts.
  - 2. Floor drains.
  - 3. Floor sinks.
  - 4. Roof flashing assemblies.
  - 5. Miscellaneous sanitary drainage piping specialties.
  - 6. Flashing materials.
  - 7. Sand Trap
  - 8. Flammable interceptors

### 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 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
  - 1. Cleanouts
  - 2. Floor drains/Floor sinks
  - 3. Sand traps

- 4. Flammable waste traps
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

**1.05 QUALITY ASSURANCE**

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

**1.06 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

**PART 2 - PRODUCTS**

**2.01 BACKWATER VALVES**

- A. Horizontal, Cast-Iron Backwater Valves:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - 2. Standard: ASME A112.14.1.
  - 3. Size: Same as connected piping.
  - 4. Body: Cast iron.
  - 5. Cover: Cast iron with bolted or threaded access check valve.
  - 6. End Connections: Hub and spigot or hubless.



7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
8. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
  - c. Watts Drainage Products Inc.
  - d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Canplas LLC.
  - b. IPS Corporation.
  - c. NDS Inc.
  - d. Oatey.
  - e. Plastic Oddities; a division of Diverse Corporate Technologies.
  - f. Sioux Chief Manufacturing Company, Inc.
  - g. Zurn Plumbing Products Group; Light Commercial Operation.
2. Size: Same as connected piping.
3. Body: PVC.
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

## 2.02 CLEANOUTS

A. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Oatey.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.

- f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Light Commercial Operation.
  - h. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M
  3. Size: Same as connected branch.
  4. Type: Threaded, adjustable housing.
  5. Body or Ferrule: Cast iron.
  6. Outlet Connection: Inside calk, Spigot or Threaded.
  7. Closure: Brass plug with tapered threads
  8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
  9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
  10. Frame and Cover Shape: Round.
  11. Top Loading Classification: Medium Duty.
  12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
  13. Jay R. Smith Model Numbers:
    - a. Concrete Floors: 4100 Series.
    - b. Carpeted Floors: 4020 Series, carpet clamping type.
    - c. Finished Walls: 4530 Series.
    - d. Terrazzo Floors: 4180 Series.
    - e. Tile Floors: 4040 Series.

**B. Metal Wall Cleanouts:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, stainless-steel cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover for drywall installation.

**2.03 FLOOR DRAINS**

**A. Cast-Iron Floor Drains (FDX):**

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith: Model 2005-B or 2010-B or a comparable product by one of the following:
  - a. Josam Company; Josam Div.

- b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Light Commercial Operation.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3
  3. Pattern: Floor drain.
  4. Body Material: Cast Iron
  5. Seepage Flange: Required if floor contains waterproofing membrane.
  6. Clamping Device: Required if floor contains waterproofing membrane.
  7. Outlet: Bottom
  8. Backwater Valve: Not required.
  9. Coating on Interior and Exposed Exterior Surfaces: Not required
  10. Top or Strainer Material: Cast iron
  11. Top of Body and Strainer Finish: Nickel Bronze
  12. Top Shape: Square
  13. Dimensions of Top or Strainer: Varies with outlet size.

B. Cast-Iron Floor Drains (FSX):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith: Model 3100 or a comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Light Commercial Operation.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3
3. Pattern: Floor sink.
4. Body Material: Cast Iron
5. Seepage Flange: Required if floor contains waterproofing membrane.
6. Clamping Device: Required if floor contains waterproofing membrane.
7. Outlet: Bottom
8. Backwater Valve: Not required.
9. Coating on Interior and Exposed Exterior Surfaces: Not required
10. Sediment Bucket: Not required
11. Top or Strainer Material: Nickel bronze.
12. Top of Body and Strainer Finish: Nickel bronze.
13. Top Shape: Square, ½ grate.
14. Dimensions of Top or Strainer: 8-1/2 inches.
15. Top Loading Classification: Light duty.
16. Funnel: Not required unless otherwise noted on plans.

**2.04 ROOF FLASHING ASSEMBLIES**

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; Elmdor/Stoneman Div.
  - b. Thaler Metal Industries Ltd.
  
- B. Description: Manufactured assembly made of 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch- (2.4-mm-) thick, lead flashing collar and skirt extending at least 8 inches (200 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
  1. Open-Top Vent Cap: Without cap.
  2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
  3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

**2.05 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
  
- 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) 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.

## 2.06 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft. (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.

## **2.07 SAND TRAP**

- A. Sand Trap:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide:
    - a. MIFAB, Inc.
    - b. Rockford Sanitary Systems, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Schier Products Company
    - e. Watts Drainage Products Inc.
  2. Type: Factory-fabricated separator for separating and removing solids from wastewater.
  3. Body Material: 3/8" high density polyethylene.
  4. Cover: Polyethylene with stainless steel bolts. Load capacity of 500 lbs.
  5. Body Dimensions: 35"x26"x32.5".
  6. Liquid Capacity: 50 gallons.
  7. Flow Rate: 50 gpm.
  8. Inlet and Outlet Size: See schedule or plan.
  9. Test tank to 5 PSI.
  10. Outlet diffuser shall be removable to inspect/clean piping.
  11. Integral air relief / anti-siphone.
  12. Internal components shall be removable for easy maintenance.
  13. Provide custom extension as required to match inlet/outlet and finished floor elevations.
  14. Meet Minnesota State Plumbing Code.

## **2.08 FLAMMABLE SEPERATOR**

- A. Flammable Seperator:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Striem FLI-275 or approved equal:
    - a. MIFAB, Inc.
    - b. Rockford Sanitary Systems, Inc.
    - c. Striem
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - e. Watts Drainage Products Inc.
  2. Type: Factory-fabricated separator for separating and removing flammable liquids from wastewater.
  3. Body Material: Seamless polyethylene
  4. Interior Lining: Not required
  5. Exterior Coating: Not required

6. Cover: H2O rated cover plate – heavy duty traffic, bolted and gasketed with counterbored stainless steel hex head bolts.
7. Holding Capacity: 275 gallons liquid, 141.4 gallons flammable liquid, 116.5 gallons sand
8. Inlet and Outlet Size: 4"
9. Test tank to 5 PSI.
10. Provide adjustable riser extensions.
11. Meet Minnesota State Plumbing Code requirements. Sizing shall be approved by the AHJ prior to installation.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install 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 roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

- G. Assemble open drain fittings and install with top of hub 1 inch (25 mm) above floor.
- H. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection. As indicated on plan(s).
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- M. Install wood-blocking reinforcement for wall-mounting-type specialties.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.03 FLASHING INSTALLATION**

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (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 Division 07 Section "Sheet Metal Flashing and Trim."
  - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
  - G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

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

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

#### **3.05 PROTECTION**

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319



## **SECTION 223100 - DOMESTIC WATER SOFTENERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes commercial water softeners.
  - 1. Chemicals.
  - 2. Water testing kits.

#### **1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FRP: Fiberglass-reinforced plastic.
- C. PE: Polyethylene plastic.
- D. PVC: Polyvinyl chloride plastic.

#### **1.4 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Water Softeners. Include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 2. Water testing kits.
- B. Shop Drawings: For water softeners. Include plans, elevations, sections, details, and connections to piping systems.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

## **1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water softeners and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- 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. ASME Compliance for Steel Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, where indicated.
- D. ASME Compliance for FRP Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section X, where indicated.
- E. This section specifies a system or part of a system being commissioned as defined in 00 18 11 General Commissioning Requirements. Testing of these systems is required in cooperation with the Owner's Representative, Construction Management Team, and the Commissioning Professional. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to 00 18 11 General Commissioning Requirements for detailed commissioning requirements.

## **1.6 MAINTENANCE SERVICE**

- A. Maintenance: Submit four copies of manufacturer's "Agreement for Continued Service and Maintenance," before Substantial Completion, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Include one-year term of agreement with option for one-year renewal.

## **1.7 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

## **1.8 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softener that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures of mineral and brine tanks.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
    - d. Attrition loss of resin exceeding 3 percent per year.
    - e. Mineral washed out of system during service run or backwashing period.
    - f. Effluent turbidity greater and color darker than incoming water.
    - g. Fouling of underdrain system, gravel, and resin, with turbidity or by dirt, rust, or scale from softener equipment or soft water, while operating according to manufacturer's written operating instructions.

2. The equipment manufacturer shall provide a warranty of one year from the time of substantial completion, or eighteen months from the time of delivery, which ever is shorter against defects in materials and/or workmanship of the mechanical operation. The pressure vessel(s) shall include a full five-year warranty from date of manufacture, when operated under normal conditions. Vessel(s) are not warranted to withstand a vacuum of more than 5 inches of Hg (mercury).

#### **1.9 MAINTENANCE SERVICE**

- A. Maintenance: Submit three copies of manufacturer's "Agreement for Continued Service and Maintenance," before Substantial Completion, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Include one-year term of agreement with option for one-year renewal.

#### **1.10 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Salt for Brine Tanks: Furnish a completely filled salt storage tank upon substantial completion.

### **PART 2 - PRODUCTS**

#### **2.1 COMMERCIAL WATER SOFTENERS**

- A. Description: Factory-assembled, pressure-type water softener.
  1. Manufacturers:
    - a. Culligan International Company.
    - b. Water Control Corp.
    - c. Robert B. Hill
- B. Unit shall be a duplex softener with a single brine tank. Softeners shall be PLC controlled and capable of progressive flow based on metered flow rates.
- C. Softener resin tank(s) shall be constructed of continuous fiberglass roving. The laminate matrix shall be epoxy with a glass transition temperature of 30°F higher than maximum use temperature. The tank support base shall be a skirt style, constructed of rigid one-piece ABS. All pressure vessels shall conform to NSF standards.
- D. Brine tank will be molded of non-toxic, corrosion-proof, high-density polyethylene, with an overlapping and bulk storage fill cover. The brine system shall include an automatic air-check assembly, brine well and gasketed salt platform and grid set.
- E. Provide bulk storage delivery piping and building termination at building exterior. Coordinate termination with Owner's bulk salt delivery contractor.

- F. The control valve(s) shall be motor driven type constructed of lead free yellow brass. Each valve shall be designed to mount directly to the top dome of each softener vessel. The valve(s) shall be set to operate at 15 lbs. salting per cubic foot of resin. Reduced salt settings are not acceptable. Each valve shall include an independent and fully adjustable cycle timer for purposes of setting/changing regeneration cycle times. Valves shall also include a built-in brine injector and backwash flow controller.
- G. Electronic Process Controller: The water softening system shall include a digital display process controller, factory mounted to the main operating control valve. The process controller(s) shall receive electronic signals from flow sensor(s) and regenerate immediately when the volume remaining has reached zero on the process controller display. Built in metered regeneration delays are not acceptable. In addition, the process controller(s) shall provide the following system status displays: volume remaining, gallons per minute flow rates, soft water totalization, and alarm functions. On multiple tank systems, the controllers shall interface together via shielded interconnecting low voltage wiring and automatically initiate progressive flow to place stand-by units on/off line on the basis of metered flow. The controller shall provide for a system pre-flush prior to placing a stand-by unit on line.
- H. The system shall include remote mounted effluent water meters, manufactured by the same company as the control valves for ease of integration and serviceability. The meters shall include a fully adjustable meter capacity range of 1,250 – 21,250 gallons. Meter shall be programmed and/or calibrated by a factory-trained technician at time of initial start-up.
- I. The water softening resin shall be virgin, sulphonated polystyrene gel type, stable over the entire pH range with good resistance to osmotic shock. Resin shall be designed to provide not less than 30,000 grains at 15 lbs. salting. Cation resins must comply with the food additive regulations set forth by the USFDA.
- J. The water softening system shall be designed to meet the following characteristics. Deviations are not acceptable.
- K. Contractor shall be responsible for all power and interconnecting wiring. Electrical rating is 120V, 60 Hz, Single Phase.
- L. Contractor shall be responsible for the loading of the media.
- M. Include the following factory-installed accessories:
  - 1. Piping, valves, drains, and pressure gages.
  - 2. Sampling cocks.
  - 3. Main-operating-valve position indicators.
  - 4. Water meters.

## **2.2 CHEMICALS**

- A. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.
  - 1. Exchange Capacity: 30,000 grains/cu. ft. (69 kg/cu. m) of calcium carbonate of resin when regenerated with 15 lb (6.8 kg) of salt.
- B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

1. Form: Plain salt pellets or crystallized solar salt from shallow ponds and milled into irregular particles

### **2.3 WATER TESTING SETS**

- A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

### **2.4 SOURCE QUALITY CONTROL**

- A. Hydrostatically test mineral tanks before shipment to minimum of one and one-half times pressure rating.
- B. Prepare test reports.

## **PART 3 - EXECUTION**

### **3.1 WATER SOFTENER INSTALLATION**

- A. Install commercial water softener equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor mineral and brine tanks and floor-mounting accessories to substrate.
- B. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.
- C. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.
- D. Install water testing sets mounted on wall, unless otherwise indicated, and near water softeners.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Make piping connections between water-softener-unit headers and dissimilar-metal water piping with dielectric fittings. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank, and on inlet and outlet headers.
  1. Metal general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
  2. Exception: Water softeners with factory-installed shutoff valves at locations indicated.

- E. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank.
  - 1. Exception: Water softeners with factory-installed pressure gages at locations indicated.
- F. Install full sized, valved bypass water piping around water softeners.
  - 1. Metal general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
  - 2. Water piping is specified in Division 22 Section "Domestic Water Piping."
- G. Install drains as indirect wastes to spill into open drains or over floor drains/sinks.
- H. Install bulk salt delivery piping and exterior connection.
- I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 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. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning water softeners that do not pass tests and inspections and retest as specified above.

### **3.4 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
- B. Add water to brine tanks and fill with salt.
- C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:
  - 1. ASTM D 859, "Test Method for Silica in Water."
  - 2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
  - 3. ASTM D 1068, "Test Methods for Iron in Water."



4. ASTM D 1126, "Test Method for Hardness in Water."
5. ASTM D 1129, "Terminology Relating to Water."
6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water softeners. Refer to Division 01 "Demonstration and Training" Section

### **3.6 FUNCTIONAL PERFORMANCE TESTING**

- A. System functional performance testing is part of the Commissioning Process as detailed in 00 18 11 General Commissioning Requirements. Functional performance testing shall be performed by the contractor and witnessed and documented by the Commissioning Professional.

END OF SECTION 223100



## **SECTION 22 40 00 - PLUMBING FIXTURES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes the following:
  - 1. Faucets for lavatories, showers/tubs and sinks.
  - 2. Protective Shielding Guards
  - 3. Fixture Supports
  - 4. Water closets.
  - 5. Lavatories.
  - 6. Kitchen sinks.
  - 7. Service sinks.
  - 8. Washer Boxes.
  - 9. Tub / Shower Surrounds.
  - 10. Shower.
  - 11. Laundry Sink.
  
- B. Related Sections include the following:
  - 1. Division 22 Section "Drinking Fountains and Water Coolers"

#### **1.02 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
  
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
  
- C. FRP: Fiberglass-reinforced plastic.
  
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
  
- E. PVC: Polyvinyl chloride plastic.
  
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

#### **1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
  
- B. Shop Drawings: Diagram power, signal, and control wiring.
  
- C. Operation and maintenance data.

#### **1.04 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.

- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
  2. Plastic Laundry Trays: ANSI Z124.6.
  3. Plastic Shower Enclosures: ANSI Z124.2.
  4. Plastic Sinks: ANSI Z124.6.
  5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
  6. Slip-Resistant Bathing Surfaces: ASTM F 462.
  7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
  8. Stainless-Steel Residential Sinks: ASME A112.19.3.
  9. Vitreous-China Fixtures: ASME A112.19.2M.
  10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
  11. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
  2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
  3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  4. Faucets: ASME A112.18.1.
  5. Hose-Connection Vacuum Breakers: ASSE 1011.
  6. Hose-Coupling Threads: ASME B1.20.7.
  7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  8. NSF Potable-Water Materials: NSF 61.
  9. Pipe Threads: ASME B1.20.1.
  10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  11. Supply Fittings: ASME A112.18.1.
  12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for shower faucets:
  1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
  2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
  3. Faucets: ASME A112.18.1.
  4. Hand-Held Showers: ASSE 1014.
  5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
  6. Hose-Coupling Threads: ASME B1.20.7.
  7. Manual-Control Antiscald Faucets: ASTM F 444.
  8. Pipe Threads: ASME B1.20.1.
  9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
  10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
  11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  1. Atmospheric Vacuum Breakers: ASSE 1001.
  2. Brass and Copper Supplies: ASME A112.18.1.
  3. Dishwasher Air-Gap Fittings: ASSE 1021.
  4. Manual-Operation Flushometers: ASSE 1037.
  5. Plastic Tubular Fittings: ASTM F 409.
  6. Brass Waste Fittings: ASME A112.18.2.
  7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
  2. Flexible Water Connectors: ASME A112.18.6.
  3. Grab Bars: ASTM F 446.
  4. Hose-Coupling Threads: ASME B1.20.7.
  5. Off-Floor Fixture Supports: ASME A112.6.1M.
  6. Pipe Threads: ASME B1.20.1.
  7. Plastic Toilet Seats: ANSI Z124.5.
  8. Supply and Drain Protective Shielding Guards: ICC A117.1.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

1. Water Closets - American Standard
  2. Lavatories: American Standard
  3. Toilet Seats: American Standard
  4. Lavatory Faucets: Delta 'Commercial'
  5. Sink Faucets: American Standard, Delta 'Commercial', Grohe, Symmons, Speakmen, Zurn,
  6. Stainless Steel Sinks: Elkay, Dayton, Sanigaard, Franke, Swan,
  7. Shower Valves: Symmons 'SafetyMix', American Standard, Delta 'Commercial', Grohe, Zurn.
  8. Hydrants and Carriers: Woodford, Josam, Wade, Smith, Watts, Zurn.
  9. Tubs: Best Bath, American Standard, warm rain.
- B. Fixture numbers below refer to the fixture numbers on the drawings.
- C. HB-1 – Exterior Hose Bibb
1. Fixture: Flush freezeless wall mounted unit: ¾" garden hose outlet connection, ¾" NPS inlet connection, with anodized aluminum recessed box and lockable door, ASSE 1052 vacuum backflow preventer two independent check valves, automatic drain when hose is removed, furnish with tee key. Manufacturer: Woodford model B67 or approved equal.
- D. L-1 – Wall hung – 4" Centers
1. Fixture: American Standard "Aqualyn" #0476.028, 20" x 17" oval vitreous china, self-rimming lavatory drilled for 4" centerset faucet.
  2. Faucet: Washerless single lever handle faucet, aerator, 1.2 GPM maximum flow, chrome finish, ADA compliant. Manufacturers: Delta 520-DST
  3. Drain: Pop-up drain including horizontal and vertical rods, with vandal resistant option.
  4. Supply: 3/8" wall supplies, escutcheon plate, flexible tube riser, handled stops with chrome finish Brass Craft model OCR19.
- E. L-2 – Wall hung – ADA - 4" Centers
1. Fixture: White vitreous china, 20' x 18" nominal dimensions, concealed arm installation faucet ledge, self-draining deck, front overflow, 4" centers, front overflow. Floor mounted, concealed arm carrier for support. Manufacturer: American Standard "Lucerne" #0355.012
  2. Faucet: Washerless single lever handle faucet, aerator, 1.2 GPM maximum flow, chrome finish, ADA compliant. Manufacturers: Delta 520-DST
  3. Drain: Pop-up drain including horizontal and vertical rods, with vandal resistant option.
  4. Supply: 3/8" wall supplies, escutcheon plate, flexible tube riser, handled stops with chrome finish Brass Craft model OCR19.
  5. Wrap: flexible vinyl insulate waste and water supply piping covers complete with internal ribs, out of sight fastening system and weep hole in base of trap. Manufacturer: Truebro Lav Guard2.

- F. SH-1, Shower
1. Best Bath System, #LSS6333A75B, overall dimension 63" x 78 ¾", wheelchair roll-in, one piece smooth surface, fiberglass shower unit with gelcoat finish and slip resistant floor. Unit fully reinforced back for site grab bar installation. Provide a combination of ½" tri-cell laminate core and ½" plywood backing. Unit to have a ½" high threshold, when installed above finish floor. Provide 1 3/8" collapsible rubber water retainer.
  2. Trim: Delta shower trim #T17094 Series and valve body #R1000-UNWS for back to back installation, single handle, pressure balance, volume and temperature control, field adjustable hot water limit on handle. Provide hand held shower wand Waterpik EcoFlow 3 Mode #VBE-453, 1.5 gpm, chrome with water pause toggle switch without a check valve. Provide an inline vacuum breaker shall be Powers, type W #141-319 chrome plated. Also provide a wall elbow with 5 foot vinyl hose and 2'-0" slide/grab bar.
- G. S-1 - Stainless Steel Sink, 2 Compartment, 33" x 19-1/2" x 7 5/8"D.
1. Sink: Double compartment, counter mounted, self-rimming, 20 gauge 304 stainless steel, 14" x 14" x 7 7/8" deep bowls, faucet ledge, undercoated for sound, two, three or four holes, hole spacing to match faucet plus one additional for dishwasher air gap fitting. Manufacturers: Elkay DSE23319 or approved equal. *\*sink needs to fit in 36" wide base cabinet.*
  2. Faucet: Single lever control faucet and aerator, 10" swing spout with (1.5 gpm) aerator, spray attachment, chrome finish. Delta model 140-WE-DST or approved equal.
  3. Drain: Stainless steel body, stainless conical strainer, removable lift-up knob with neoprene stoppers, 1 1/2" chrome plated brass adjustable offset tailpieces with Insinkerator Model 444S garbage disposal, 17 gauge tubing waste to wall, chrome escutcheon. Elkay LK105CR counter mounted air gap fitting with piping to connect from dishwasher to air gap fitting to garbage disposal.
  4. Supply: 3/8" wall supplies, escutcheon plate, flexible tube riser, handled stops with chrome finish Brass Craft model OCR19.
- H. S-2, Stainless Steel Sink, Double Compartment, 33" x 22" x 5 1/2"D, 18 Gauge, ADA
1. Sink: Double compartment, counter mounted, self-rimming, 20 gauge 302 stainless steel, 14" x 15 3/4" x 5 3/8" deep bowls, off-centered drain, faucet ledge, undercoated for sound, two, three or four holes, hole spacing to match faucet plus one additional for dishwasher air gap fitting. Manufacturers: Dayton, Elkay GEGR3321 ADA or approved equal. *\*sink needs to fit in 36" wide base cabinet.*
  2. Faucet: Single lever control faucet and aerator, 10" swing spout with (1.5 gpm) aerator, spray attachment, chrome finish. Delta model 140-WE-DST or approved equal.
  3. Drain: Stainless steel body, stainless conical strainer, removable lift-up knob with neoprene stoppers, 1 1/2" chrome plated brass adjustable offset tailpieces with dishwasher connection, p-traps, 17 gauge tubing waste to wall, chrome escutcheon. Elkay LK105CR counter mounted air gap fitting with piping to connect from dishwasher to air gap fitting to tail piece.
  4. Supply: 3/8" wall supplies, escutcheon plate, flexible tube riser, handled stops with chrome finish Brass Craft model OCR19.
  5. Wrap: flexible vinyl insulate waste and water supply piping covers complete with internal ribs, out of sight fastening system and weep hole in base of trap. Manufacturer: Truebro Lav Guard2.
- I. T-1 – Tub/Shower
1. Tub: Recess bath with textured bottom, integral skirt and integral nailing flange. Coordinate color with Architect. Coordinate right/left hand orientation with Architect. Manufacturer: American Standard Princeton
    - a. Dimensions: 60" L x 30" W x 14" H.
  2. Valve: Tub/shower trim with zinc sip fit diverter tub spout, single handle, pressure balance, anti-scald with integral check stops, temperature controls only. Field adjustable temperature limit stop, 1.5 gpm shower head with rigid shower arm. Manufacturers: Delta T13491-LHD with RP38357 Showerhead, RP5834 Pull Up Diverter and R10000 Series rough in. Provide ASSE 1070 thermostatic mixing valve on supply piping. Locate in an accessible location or provide access panel for service.

3. Drain: Provide Brass Tub Drain kit assembly complete with overflow plate, toe-operated drain mechanism; drain body; sealing washer; Drain Ell and tube; bushing for tubular pipe; elbow. Delta model RP393.
- J. MB-1 - Janitor's Sink - 24" x 24"
1. Fixture: 24" x 24" x 10" keep, crushed stone, vinyl bumper guard, and polyester resin construction. Manufacturers: Fiat Model MSB 2424; Swan MS2424-3; Stern-Williams MTB 2424.
  2. Trim: 30" long heavy duty rubber hose 5/8" (with hose bracket 302 stainless steel and rubber grip, mop hanger 24" long with (3) rubber grips.
  3. Faucet: Double faucet with vacuum breaker, 2-1/2" lever handles, 3/4" hose threaded spout, adjustable wall brace, pail hook, flanged arms with integral stops, rough chrome finish. Manufacturers: Delta "Commercial" 28T9-AC
  4. Drain: 3" cast brass, chrome plated with dome type strainer and lint basket made from Type 302 stainless steel.
- K. WMT-1 Washer Box :
1. Basis-of-Design Product: Subject to compliance with requirements, provide Oatey #38957 or a comparable product by one of the following:
    - a. Oatey, Inc.
    - b. Guy Grey, Inc.
  2. Description: Washing Machine Outlet Box. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
    - a. Body Material: High Impact Polystyrene.
    - b. Finish: White High Impact Polystyrene.
    - c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
    - d. Mixing Valve: Not required.
    - e. Mounting: Wall mounted.
    - f. Handle(s): Levers.
    - g. Inlet(s): NPS 1/2 male shank or NPS 1/2 female shank.
    - h. Operation: 1/4" Turn Ball Valves.
    - i. Drain: 2" Waste.
  3. Provide Duraflex Washer Pan with integral drain. White.
- L. WC-1 - Floor Mounted – Tank Type – Elongated Bowl, 1.28 gpf
1. Fixture: Vitreous china bowl, siphon jet action, floor mounted, 2-1/8" siphon trapway, close coupled tank with "Cadet flushing system" two bolt caps and floor anchor with stainless steel bolts, 1000 gram MAP flush test capacity 17" height with seat, 10 year warranty. Manufacturer: American Standard Cadet Pro Right Height, #215AA.104
  2. Seat: Heavy duty solid plastic for elongated bowl, closed front with cover, white, stainless steel posts, *all locations unless indicated on plans as open front seat*. Manufacturer: American Standard.

## 2.02 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers,:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Plumberex Specialty Products Inc.
    - b. TRUEBRO, Inc.
    - c. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
  2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
    - a. Trap Standard: NPS 2 enameled, cast iron with cleanout and floor flange.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.



- S. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Connect inlet hose to dishwasher and outlet hose to disposer.
- T. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
- U. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."
- V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.03 FIELD QUALITY CONTROL**

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### **3.04 PROTECTION**

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION**



# SECTION 230500 - COMMON WORK RESULTS FOR HVAC

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Flexible connectors.
  - 5. Mechanical sleeve seals.
  - 6. Sleeves.
  - 7. Escutcheons.
  - 8. Grout.
  - 9. Mechanical demolition.
  - 10. Equipment installation requirements common to equipment sections.
  - 11. Supports and anchorages.

### 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### **1.04 SUBMITTALS**

A. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

#### **1.05 QUALITY ASSURANCE**

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of different electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Mechanical Contractor will be responsible to coordinate and pay for all electrical contractor changes required to substitute equipment that has different electrical characteristics than designed.

E. Mechanical contractor will also be responsible to coordinate and pay for all general contractor changes required to substitute equipment that has a higher weight, and/or has a different footprint than designed.

F. Mechanical contractor will be responsible to coordinate and pay for all Architect/Engineering fees required to redesign for substituted equipment.

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

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## **1.07 COORDINATION**

- A. Coordinate mechanical equipment installation with other building components. Mechanical contractor will be required to pay for all required openings not shown on Architectural or Structural drawings. Mechanical contractor shall pay the Architect/Engineer fees to design openings.
- B. Mechanical contractor to coordinate installation requirements and construction schedules to install mechanical equipment in new or existing facilities. The mechanical contractor will not be eligible for any additional monetary compensation due to the need to disassemble and reassemble mechanical equipment due to not meeting construction schedules or coordinating with existing conditions.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels with general contractor and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- H. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 - PRODUCTS**

### **2.01 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.02 JOINING MATERIALS**

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

- a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
  - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.

### **2.03 TRANSITION FITTINGS**

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
  - 2. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
  - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

## **2.04 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- G. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

## **2.05 FLEXIBLE CONNECTORS**

- A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig (860-kPa) minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
  - 1. 2-Inch NPS (DN50) and Smaller: Threaded.
  - 2. 2-1/2-Inch NPS (DN65) and Larger: Flanged.
  - 3. Option for 2-1/2-Inch NPS (DN65) and Larger: Grooved for use with keyed couplings.
- B. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.
- E. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 125-psig (860-kPa) minimum working-pressure rating at 220 deg F (104 deg C). Units may be straight or elbow type, unless otherwise indicated.

## **2.06 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## **2.07 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## **2.08 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.



- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## **2.09 GROUT**

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.01 HVAC DEMOLITION**

- A. Refer to Division 01 Section "Execution" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### **3.02 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion,

pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - k. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
    - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.03 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Non-pressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

### **3.04 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect-Engineer.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment to allow right of way for piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.
- G. Complete commissioning pre-start checklist prior to startup.
- H. Provide manufacturers startup documentation.
- I. Field electrical wiring required for remote manufacture provided accessories shall be provided by this contractor.

### **3.06 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- B. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- C. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- D. Field Welding: Comply with AWS D1.1.

### **3.07 GROUTING**

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.

- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

# SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 - GENERAL

### 1.01 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 basic requirements for factory-installed and field-installed motors.
- B. Related Sections include the following:
  - 1. Division 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.

### 1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

### 1.04 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:
  - 1. Compatible with the following:
    - a. Magnetic controllers.
    - b. Multispeed controllers.
    - c. Reduced-voltage controllers.
  - 2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
  - 3. Matched to torque and horsepower requirements of the load.
  - 4. Matched to ratings and characteristics of supply circuit and required control sequence.

## **PART 2 - PRODUCTS**

### **2.01 MOTOR REQUIREMENTS**

- A. Motor requirements apply to factory-installed and field-installed motors except as follows:
  - 1. Different ratings, performance, or characteristics for a motor are specified in another Section.
  - 2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

### **2.02 MOTOR CHARACTERISTICS**

- A. Motors 3/4 HP and Larger: Three phase.
- B. Motors Smaller Than 1/2 HP: Single phase.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
- G. 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.
- H. Enclosure: Open dripproof or TEFC.
- I. EFFICIENCY: PREMIUM EFFICIENCY FOR ALL MOTORS 3 HP AND HIGHER AS DEFINED BY CURRENT NEMA STANDARD AND FOLLOWING CHARTS.



<b>Enclosed Motors</b>	<b>2012 efficiency requirements</b>		
<b>Totally Enclosed Fan-Cooled</b>	<b>RPM</b>		
<b>Motor (HP)</b>	<b>1200</b>	<b>1800</b>	<b>3600</b>
1	84	86.5	78.5
1.5	88.5	87.5	85.5
2	89.5	87.5	86.5
3	90.2	90.2	87.5
5	90.2	90.2	89.5
7.5	91.7	92.4	90.2
10	91.7	92.4	91
15	92.4	93	91.7
20	92.4	93.6	91.7
25	93.6	94.1	92.4
30	93.6	94.1	92.4
40	94.5	94.5	93
50	94.5	95	93.6
60	95	95.4	94.1
75	95	95.8	94.1
100	95.4	95.8	94.5
<b>Open Motors</b>	<b>2012 efficiency requirements</b>		
<b>Open Drip-Proof</b>	<b>RPM</b>		
<b>Motor (HP)</b>	<b>1200</b>	<b>1800</b>	<b>3600</b>
1	84	86.5	78.5
1.5	87.5	87.5	85.5
2	88.5	87.5	86.5
3	89.5	90.2	86.5
5	90.2	90.2	87.5
7.5	91	91.7	89.5
10	92.4	92.4	90.2
15	92.4	93.6	91
20	93	93.6	91.7
25	93.6	94.1	92.4
30	94.1	94.5	92.4
40	94.5	94.5	93
50	94.5	95	93.6
60	95	95.4	94.1
75	95	95.4	94.1
100	95.4	95.8	94.1

J. Provide shaft grounding kits on all motors over 3 HP and with a VFD.

**2.03 POLYPHASE MOTORS**

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. EFFICIENCY: PREMIUM EFFICIENCY FOR ALL MOTORS 3 HP AND HIGHER AS DEFINED BY CURRENT NEMA STANDARD AND FOLLOWING CHARTS.

<b>Enclosed Motors</b>	<b>2012 efficiency requirements</b>		
<b>Totally Enclosed Fan-Cooled</b>	<b>RPM</b>		
<b>Motor (HP)</b>	<b>1200</b>	<b>1800</b>	<b>3600</b>
1	84	86.5	78.5
1.5	88.5	87.5	85.5
2	89.5	87.5	86.5
3	90.2	90.2	87.5
5	90.2	90.2	89.5
7.5	91.7	92.4	90.2
10	91.7	92.4	91
15	92.4	93	91.7
20	92.4	93.6	91.7
25	93.6	94.1	92.4
30	93.6	94.1	92.4
40	94.5	94.5	93
50	94.5	95	93.6
60	95	95.4	94.1
75	95	95.8	94.1
100	95.4	95.8	94.5

<b>Open Motors</b>	<b>2012 efficiency requirements</b>		
<b>Open Drip-Proof</b>	<b>RPM</b>		
<b>Motor (HP)</b>	<b>1200</b>	<b>1800</b>	<b>3600</b>
1	84	86.5	78.5
1.5	87.5	87.5	85.5
2	88.5	87.5	86.5
3	89.5	90.2	86.5
5	90.2	90.2	87.5
7.5	91	91.7	89.5
10	92.4	92.4	90.2
15	92.4	93.6	91
20	93	93.6	91.7
25	93.6	94.1	92.4
30	94.1	94.5	92.4
40	94.5	94.5	93
50	94.5	95	93.6
60	95	95.4	94.1
75	95	95.4	94.1
100	95.4	95.8	94.1

C. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

- D. Rotor: Squirrel cage, unless otherwise indicated.
- E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
- F. Temperature Rise: Match insulation rating, unless otherwise indicated.
- G. Insulation: Class F, unless otherwise indicated.
- H. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or G.
  - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5.
  - 1. Finish: Gray enamel.

#### **2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS**

- A. Motors Used with Reduced-Inrush 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. Designed with critical vibration frequencies outside operating range of controller output.
  - 2. Temperature Rise: Matched to rating for Class B insulation.
  - 3. Insulation: Class H.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.
- D. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:
  - 1. Measure winding resistance.
  - 2. Read no-load current and speed at rated voltage and frequency.
  - 3. Measure locked rotor current at rated frequency.
  - 4. Perform high-potential test.
- E. Provide shaft grounding kits on all motors over 3 HP.

#### **2.05 SINGLE-PHASE MOTORS**

- A. Type: One of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split-phase start, capacitor run.
  - 3. Capacitor start, capacitor run.
  - 4. ECM

- B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.
- C. 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.
- D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

### **PART 3 - EXECUTION**

#### **3.01 ADJUSTING**

- A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

#### **3.02 CLEANING**

- A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 230513



## SECTION 230514 - VARIABLE FREQUENCY DRIVES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. This Section includes basic requirements for variable frequency drives.

#### 1.02 SUBMITTALS

- A. General: Submit the following in accordance with conditions of Contract and Division 01 Specification Sections.
  - 1. Product data indicating drive voltage, switching frequency, full load amp (FLA) and horsepower ratings, dimensions, weights, furnished specialties and accessories.
  - 2. Wiring diagrams detailing wiring for power, signal, and control systems, differentiating between manufacturer-installed wiring and field-installed wiring.
  - 3. Maintenance data for variable frequency drives for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 23 Section "Basic Mechanical Requirements".

#### 1.03 QUALITY ASSURANCE

- A. Each new product design shall undergo a 4000 hour pre-production burn-in test. Up to ten units may be used to accumulate this entire time. Each unit shall be temperature cycled between 0 and 50°C during this time period.
- B. Digital integrated circuits shall undergo functional and reliability tests. Regulator circuits must use reliable and compact surface mount construction. These circuits shall be 100% tested on computer controlled systems. Test equipment must be documented, controlled and calibrated to ISO 9001 standards.
- C. Each drive power circuit shall be tested under motor load conditions. While loaded, the output waveform shall be monitored for correct PWM algorithm. Short circuit testing shall be done to UL standards.
- D. Every VFD shall be functionally tested under motor load. During this load test the VFD shall be monitored for correct phase current, phase voltages, and motor speed. Correct Current Limit operation shall be verified by simulating a motor overload. Manufacturing test data on each drive manufactured shall be recorded via bar codes and stored by the manufacturer at the time of production.
- E. A hi-pot voltage test shall be performed using at least 2715 VDC. Leakage currents during this test must not exceed 100 micro amps. This test insures proper grounding procedures have been followed during manufacturing.
- F. Verification of proper factory presets shall performed on 100% of all parameters to ensure proper microprocessor settings. Verification that the proper factory settings are loaded correctly in the drive shall be done via the drive serial interface port. Any parameter changes that are required after the

addition of options such as communication cards or bypass shall be verified in addition to the drive only defaults.

- G. All options shall be functionally tested including operation of a motor in the bypass mode if supplied. Proper sizing and adjustment of the SMP II motor overload, if supplied, shall be verified.
- H. Quality control systems shall conform to the ISO9001 standard. Under this system, quality assurance for design/development, production, installation and servicing of the proposed manufactures equipment shall be certified ISO9001.
- I. National Electrical Code Compliance: Provide components complying with NFPA 70 "National Electrical Code".
- J. UL Compliance: Provide variable frequency drives which are listed and labeled by UL and comply with ANSI/UL Standard 508.
- K. All variable frequency drives shall be tested by the manufacturers. The drive shall operate a dynamometer at full load and the load and speed shall be cycled during the test. All optional features shall be functionally tested at the factory for proper operation.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
  - 1. Variable Frequency Drives:
    - a. Danfoss/Graham Company.
    - b. ABB
    - c. Yaskawa
    - d. Cutlet Hammer

### **2.02 VARIABLE FREQUENCY DRIVES**

- A. Furnish complete drives listed and labeled as a complete unit and arranged to provide variable speed of a standard NEMA Design B, 3 phase, induction motor by adjusting output voltage and frequency of drive. Drive shall be designed and rated by the manufacturer for the load with which used. Drive shall also be approved by the manufacturer for the type of connection used between motor and load.
- B. Enclosure shall be NEMA 1 with inlet air filters.
- C. The drive shall convert input voltage scheduled, three-phase, 60 Hz power to adjustable voltage and frequency, three-phase power for stepless motor speed control from 10% to 110% of the motor's 60 Hz speed.
- D. All drives shall include a converter and inverter section. Converter sections shall convert fixed frequency and voltage AC power to DC voltage. Inverter section shall invert DC voltage into a quality output waveform, with adjustable voltage and frequency for stepless motor speed control. The drive shall provide selectable voltage/frequency ratio for optimum variable torque output.



- E. All drives shall include AC input line reactors to limit harmonics and provide AC line input filtering or DC link reactor equivalent to 3% AC line reactance.
- F. Drive full load AMP rating shall meet or exceed NEC Table 430-150.
- G. Each drive shall have the following operating characteristics:
  - 1. Starting Torque: 100 percent of rated torque.
  - 2. Speed Regulation: Plus or minus 1 percent.
  - 3. Ambient Temperature: 0 to 40 deg. C.
  - 4. Efficiency: 97 percent minimum at full load, 60 Hz.
- H. Each drive shall have the following operational and interface features:
  - 1. Door mounted hand/off/auto selector switch to start and stop the drive.
  - 2. Power/on light to indicate that the drive is receiving utility power.
  - 3. Fault light to indicate that the drive has tripped on a fault condition.
  - 4. A set of contacts to indicate when the drive is in the run mode and a set of contacts to indicate when the drive is in the fault mode.
  - 5. A 0 to 10V DC output signal to vary in direct proportion to the voltage, frequency or current.
  - 6. Terminal strip to accept normally closed safety contacts such as freezestats, smoke alarms, etc. The drive shall safely shutdown when in drive or by-pass mode when contacts open.
  - 7. The drive shall accept an additional normally closed contact to interface with the hand-off-auto switch for remote stop/start control.
  - 8. The drive shall accept a 4 to 20 mA input signal.
  - 9. All drives shall be provided with fused main input disconnect, factory-mounted and wired. Drive disconnect shall be accomplished via disconnects, contactors and overloads or with a four position drive/off/line/test switch with motor starter.
  - 10. Manual speed control capability.
- I. Each drive shall have the following internal adjustment capabilities:
  - 1. Minimum Speed: Adjustable 5 to 50 percent of maximum RPM.
  - 2. Maximum Speed: Adjustable 80 to 100 percent of maximum RPM.
  - 3. Acceleration: Adjustable 3 to 60 seconds.
  - 4. Deceleration: Adjustable 3 to 60 seconds.
  - 5. Current Limit: 50 to 110 percent of maximum rating.
  - 6. Overload trip setpoint.
  - 7. Offset and gain to condition the input speed signal.
- J. Each drive shall have the following self-protection and reliability features:
  - 1. Motor Overload Relay: Adjustable and capable of NEMA Class 10 performance.
  - 2. Instantaneous overcurrent trip.
  - 3. Loss of phase protection.
  - 4. Reverse phase protection.
  - 5. Under-and over-voltage trips.
  - 6. Overtemperature trip.
  - 7. Short circuit protection.
  - 8. Automatic reset faults due to undervoltage, overvoltage, phase loss, or overtemperature.
  - 9. Status lights or digital display for indication of individual fault conditions.

## 2.03 CONTROL PANEL

- A. Control panel shall provide isolated signals to operate variable frequency drive. The controller shall include hardware and software for system speed control.
- B. The controller operator interface shall include an alpha/numeric fluorescent display and a sealed membrane keypad.
- C. Provisions for fault diagnosis and isolation shall include diagnostic software and hardware, including fault codes, LED diodes, and component replacement without special tools.
- D. Building Automation System Communications: Coordinate these requirements with the successful temperature control contractor for the appropriate RS-485 communication option card or embedded card that shall be provided to allow direct connection from the drive to:
  - 1. ModBus compatible networks.
  - 2. BacNet
  - 3. All configuration and control functions may be accessed through these cards. These option cards shall permit direct communication between the drive microprocessor and the host control system. Fault diagnostics, start/stop, speed commands, and all drive feedback variables shall be available over a single communication connection. Discrete signals such as Bypass Run or Interlock Open shall also be mapped through the drive terminal strip to the system for unitary control. The cards shall have the ability to be used in a "monitor only" mode where control shall be from an AHU or similar type controller directly wired to the drive.

## PART 3 - EXECUTION

### 3.01 VARIABLE FREQUENCY DRIVES

- A. Authorized service person shall inspect each drive before start-up and train owner on operation and service.
- B. Service engineers shall be employed by the manufacturer or be certified by the manufacturer and provide startup service including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.
- C. Electrical wiring and connections shall be as specified in Electrical sections. Coordinate installation with Electrical contractor.
- D. Turn over the drive to Electrical contractor to install on wall, unless specified to come unit mounted.

END OF SECTION 230514

# SECTION 230516 - EXPANSION FITTINGS AND LOOPS 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. Expansion compensators.
  - 2. Flexible-hose expansion joints.
  - 3. Pipe bends and loops.
  - 4. Alignment guides and anchors.

### 1.03 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

### 1.04 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

### 1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Delegated-Design Submittal: For each anchor and alignment guide 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 thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
  - 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.
- C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.
- D. Maintenance Data: For pipe expansion joints to include in maintenance manuals.

## **PART 2 - PRODUCTS**

### **2.01 EXPANSION JOINTS**

- A. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
  - 1. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder-joint end connections.
    - a. NPS 2 (DN 50) and Smaller: 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.
    - b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 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.
  - 2. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 (DN 50) and smaller and flanged or weld end connections for NPS 2-1/2 (DN 65) and larger.
    - a. NPS 2 (DN 50) and Smaller: 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.
    - b. NPS 2-1/2 to NPS 6 (DN 65 to DN 150): 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.

### **2.02 PACKLESS EXPANSION JOINTS**

- A. Rubber Expansion Joints: EPDM rubber, and pressure rated for 180 psig at 225 deg F.

1. Configuration: Full-faced, integral, flanged-end connections; external control rods; and retaining rings drilled to match flange bolt holes.
2. Type: Single or multiple bellows as scheduled.

### **2.03 GUIDES**

- A. Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

### **2.04 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
  1. Stud: Threaded, zinc-coated carbon steel.
  2. Expansion Plug: Zinc-coated steel.
  3. Washer and Nut: Zinc-coated steel.

## **PART 3 - EXECUTION**

### **3.01 EXPANSION FITTING INSTALLATION**

- A. Install expansion fittings according to manufacturer's written instructions.
- B. Install expansion fittings in sizes matching pipe size in which they are installed.
- C. Align expansion fittings to avoid end-loading and torsional stress.

### **3.02 GUIDE INSTALLATION**

- A. Install guides on piping adjoining expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

### **3.03 ANCHOR INSTALLATION**

- A. 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.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

- C. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.

END OF SECTION 230516

## **SECTION 230519 - METERS AND GAGES 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. This Section includes meters and gages for mechanical systems.

#### **1.03 SUBMITTALS**

- A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.
- B. Shop Drawings: Include schedule indicating manufacturer's number, scale range, fittings, and location for each meter and gage.
- C. Maintenance Data: For meters and gages to include in maintenance manuals specified in Division 1. Include data for the following:
  - 1. Flowmeters.

### **PART 2 - PRODUCTS**

#### **2.01 THERMOMETERS, GENERAL**

- A. Scale Range: Temperature ranges for services listed are as follows:
  - 1. Hydronic Heating Water: 30 to 300 deg F, with 2-degree scale divisions (0 to 150 deg C, with 1-degree scale divisions).
  - 2. Hydronic Chilled Water: 0 to 100 deg F, with 2-degree scale divisions (minus 18 to plus 38 deg C, with 1-degree scale divisions).
- B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

#### **2.02 LIQUID-IN-GLASS THERMOMETERS**

- A. Description: ASTM E 1.

- B. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches (230 mm) long.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Tube: Red or blue reading, organic-liquid filled with magnifying lens.
- E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
- F. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

### **2.03 DIRECT-MOUNTING, FILLED-SYSTEM DIAL THERMOMETERS**

- A. Description: Vapor-actuated, universal-angle dial type.
- B. Case: Drawn steel or cast aluminum, with 4-1/2-inch- (115-mm-) diameter, glass lens.
- C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
- D. Thermal Bulb: Copper with phosphor-bronze bourdon pressure tube.
- E. Movement: Brass, precision geared.
- F. Scale: Progressive, satin-faced nonreflective aluminum with permanently etched markings.
- G. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.

### **2.04 INSERTION DIAL THERMOMETERS**

- A. Description: ASME B40.3, bimetal type.
- B. Dial: 1-inch (25-mm) diameter.
- C. Case: Stainless steel.
- D. Stem: Dustproof and leakproof 1/8-inch- (3-mm-) diameter, tapered-end stem with nominal length of 5 inches (125 mm).

### **2.05 SEPARABLE SOCKETS**

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
  1. Material: Brass, for use in copper piping.
  2. Material: Steel, for use in steel piping.
  3. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
  4. Insertion Length: To extend to center of pipe.



5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat-Transfer Fluid: Oil or graphite.

## **2.06 THERMOMETER WELLS**

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
  1. Material: Brass, for use in copper piping.
  2. Material: Steel, for use in steel piping.
  3. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
  4. Insertion Length: To extend to center of pipe.
  5. Cap: Threaded, with chain permanently fastened to socket.
  6. Heat-Transfer Fluid: Oil or graphite.

## **2.07 PRESSURE GAGES**

- A. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
- B. Case: Drawn steel, brass, or aluminum with 4-1/2-inch- (115-mm-) diameter, glass lens.
- C. Connector: Brass, NPS 1/4 (DN8).
- D. Scale: White-coated aluminum with permanently etched markings.
- E. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.
- F. Range: Comply with the following:
  1. Vacuum: 30 inches Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
  2. Fluids under Pressure: Two times the operating pressure.
- G. Refer to "Part 3 Execution" for dry, glycerin and silicone fill medium use.

## **2.08 PRESSURE-GAGE FITTINGS**

- A. Hydronic Indicator: Brass body with four inlets and valves by Flow Conditioning Corp. (314) 878-7898 or equal.
- B. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.
- C. Syphons: NPS 1/4 (DN8) coil of brass tubing with threaded ends.
- D. Snubbers: ASME B40.5, NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

## **2.09 TEST PLUGS**

- A. Description: Nickel-plated, brass-body test plug in NPS 1/2 (DN15) fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 psig (3450 kPa) minimum.
- D. Core Insert: Self-sealing valve, suitable for inserting 1/8-inch (3-mm) OD probe from dial-type thermometer or pressure gage.
- E. Core Material for Air, Water, Oil, and Gas: 20 to 200 deg F (Minus 7 to plus 93 deg C), chlorosulfonated polyethylene synthetic rubber.
- F. Core Material for Air and Water: Minus 30 to plus 275 deg F (Minus 35 to plus 136 deg C), ethylene-propylene-diene terpolymer rubber.
- G. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
- H. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
  - 1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

## **PART 3 - EXECUTION**

### **3.01 METER AND GAGE INSTALLATION, GENERAL**

- A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.
- B. Installation of piping accessories and piping specialties shall be accomplished with the use of outlet fittings, tees or thread-o-lets. Tapping of the piping is not acceptable.
- C. Coordinate the installation requirements for the water utility meter with the utility company.

### **3.02 THERMOMETER INSTALLATION**

- A. Install thermometers and adjust vertical and tilted positions.
- B. Install in locations as detailed on the drawings.
- C. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
  - 1. Install with socket extending to center of pipe.
  - 2. Fill sockets with oil or graphite and secure caps.
- D. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
  - 1. Install with stem extending to center of pipe.

2. Fill wells with oil or graphite and secure caps.

### **3.03 PRESSURE-GAGE INSTALLATION**

- A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
- B. Install dry-type pressure gages in the following locations:
  1. Discharge of each pressure-reducing valve.
  2. Building water-service entrance.
  3. Chilled-water and condenser-water inlets and outlets of chillers.
- C. Install liquid-filled-type pressure gages at suction and discharge of each pump.
  1. Glycerin filled gages shall be used for water temperatures of 150 deg F and less.
  2. Silicone filled gages shall be used for water temperatures greater than 150 deg, F.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.

### **3.04 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
  1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.
  2. Connect flowmeter transmitters to meters. Connect power to flowmeter per manufacturer's requirements.

### **3.05 ADJUSTING AND CLEANING**

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION 230519



# SECTION 230523 - GENERAL-DUTY VALVES 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. This Section includes the following general-duty valves:
  - 1. Ball valves.
  - 2. Butterfly valves.
  - 3. Check valves.
  - 4. Globe valves.
  - 5. Plug valves.
  - 6. Chainwheel actuators.
- B. Related Sections:
  - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
  - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

### 1.03 DEFINITIONS

- A. The following are standard abbreviations for valves:
  - 1. CWP: Cold working pressure.
  - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 3. NBR: Acrylonitrile-butadiene rubber.
  - 4. PTFE: Polytetrafluoroethylene plastic.
  - 5. SWP: Steam working pressure.
  - 6. TFE: Tetrafluoroethylene plastic.
  - 7. WOG: Water, oil, gas.

### 1.04 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

## **1.05 QUALITY ASSURANCE**

- A. ASME Compliance: ASME B31.9 for building services piping valves.
  - 1. Exceptions: Domestic hot- and cold-water and sanitary waste piping valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

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

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle 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**

### **2.01 VALVES, GENERAL**

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Valves must be rated for the appropriate fluid, i.e. glycol or other fluid as indicated in the contract documents.
- C. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.
- D. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
  2. Gear Drive: For quarter-turn valves NPS 8 (DN 200) and larger.
  3. Handwheel: For valves other than quarter-turn types.
  4. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
  5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: AWWA C606.
1. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, and globe valves; below 421 deg F (216 deg C) for ball valves.
  2. Threaded: With threads according to ASME B1.20.1.
- K. Valve Bypass and Drain Connections: MSS SP-45.

## **2.02 BALL VALVES**

- A. Ball Valves: Valves shall be rated 150 psi SWP and 600 psi non-shock WOG and shall have 2-piece cast bronze bodies containing less than 15% zinc, TFE seats, full port, separate packnut with adjustable stem packing, anti-blowout stems and stainless steel ball. Valve ends shall have full depth ANSI threads or extended solder connections and be manufactured to comply with MSS-SP110.
- B. Full port valves shall be Class 150 NIBCO T585-70NS (threaded) or Class 150 Nibco S585-70NS (solder) or equal.
- C. Provide stem extension to allow up to 2-inch pipe insulation without interfering with valve operation.

## **2.03 CHECK VALVES**

- A. Check Valves (Swing Type 2-Inches and Smaller): Valves shall be Y-pattern swing-type manufactured in accordance with MSS-SP80, Class 150, bronze ASTM B-62 body with TFE stem disc. Valve ends shall be threaded type.
  1. Valves shall be Class 150 NIBCO T433-Y or Milwaukee 510T, with threaded ends or equal.
- B. Check Valves (Wafer-Style 2-Inches and Larger For Pump Discharge Applications): Class 125, 200-psi (1380-kPa) CWP, ASTM A 126, Class B, cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna-N seals, installed between flanges. Valves shall be NIBCO W920-W or equal.

## **2.04 BUTTERFLY VALVES**

- A. Valves shall be lug type body style manufactured in accordance with MSS-SP67 rated at least 200 psi non-shock cold water working pressure.
- B. Provide stem extension to allow up to 2-inch pipe insulation without interfering with valve operation.
- C. Valve body shall be ASTM A-536 cast iron or ductile iron. Valve shall have aluminum bronze alloy disc with EPDM rubber seat and seals; or EPDM rubber encapsulated disc with polymer-coated body.
- D. Stem shall be 400 Series stainless steel and shall not have exposed stem to disc fasteners.
- E. Valve sizes 2-1/2 inch through 6-inch shall be lever operated with 10-position throttling plate.
- F. Valve sizes 8-inch and larger shall have gear operators. Lug-style and grooved style shall be capable for use as isolation valves and shall be recommended by the manufacturer for dead-end service at full pressure without the need for down-stream flanges.
- G. Valves shall be lug body, aluminum bronze disc NIBCO LD2000-3 (lever operator) or LD 2000-5 (gear operator) or equal; grooved body, rubber-coated disc NIBCO GD4765-3 (lever operator); GD4765-5 (gear operator) or equal.

## **2.05 GLOBE/ANGLE VALVES**

- A. Globe/Angle Valves 2 Inches and Smaller For Domestic Water Piping and Hydronic Piping: Valves shall be Class 150 and manufactured in accordance with MSS-SP 80. Body and bonnet shall be of bronze ASTM B-62. Stems shall be of dezincification-resistant silicone bronze ASTM B-371, non-asbestos packing, TFE steam set disc and malleable or ductile iron handwheel. Valve ends shall be threaded or solder type.
  - 1. Valves shall be Class 150 NIBCO T235-Y (threaded globe), Class 150 NIBCO T335-Y (threaded angle) or equal.
- B. Globe/Angle Valves 2-1/2 Inches and Larger For Domestic Water Piping and Hydronic Piping: Valves shall be Class 125 manufactured in accordance with MSS-SP85, flanged, bolted bonnet, outside screw and yoke, cast iron body, bronze trimmed, with body and bonnet conforming to ASTM A126, Class B, cast iron. Packing and gaskets shall be non-asbestos.
  - 1. Globe valves shall be NIBCO F718-B or equal.
  - 2. Angle valves shall be NIBCO F818-B or equal.

## **2.06 CHAINWHEEL ACTUATORS**

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
  - 2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.



## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### **3.02 VALVE APPLICATIONS**

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, globe, or plug valves.
  - 2. Throttling Service: Angle, ball, butterfly, or globe valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Heating Water Systems: Use the following valve types:
  - 1. Ball Valves: Class 150, 400-psi (2760-kPa) CWP, with stem extension and memory stop.
  - 2. Globe Valves: Class 150, bronze or cast-iron body to suit piping system, and bronze disc.
  - 3. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or epoxy-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
  - 4. Bronze Swing Check: Class 150, with composition seat.
  - 5. Check Valves: Iron swing or wafer, as indicated. Swing check shall be Class 150 with bronze seat ring.
- D. Select valves, except flangeless types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water and heating hot water.
  - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends.
  - 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.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved.

### **3.03 VALVE INSTALLATION**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install chainwheel operators on 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 elevation.
- G. Install check valves for proper direction of flow and as follows:
  1. Swing Check Valves: In horizontal position with hinge pin level.
  2. Lift Check Valves: With stem upright and plumb.

### **3.04 JOINT CONSTRUCTION**

- A. Refer to Division 23 Sections for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### **3.05 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 230523

# SECTION 230529 - 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. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fiberglass pipe hangers.
  - 4. Metal framing systems.
  - 5. Fiberglass strut systems.
  - 6. Thermal-hanger shield inserts.
  - 7. Fastener systems.
  - 8. Pipe stands.
  - 9. Pipe positioning systems.
  - 10. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
  - 3. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
  - 4. Division 23 Section "Metal Ducts" for duct hangers and supports.

### 1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

### 1.04 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

#### **1.05 QUALITY ASSURANCE**

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.2, "Structural Welding Code--Aluminum."
  - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 4. ASME Boiler and Pressure Vessel Code: Section IX.

### **PART 2 - PRODUCTS**

#### **2.01 STEEL PIPE HANGERS AND SUPPORTS**

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

#### **2.02 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

#### **2.03 FIBERGLASS PIPE HANGERS**

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel
- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.

#### **2.04 METAL FRAMING SYSTEMS**

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

#### **2.05 FIBERGLASS STRUT SYSTEMS**

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

#### **2.06 THERMAL-HANGER SHIELD INSERTS**

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (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 steel, 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 STAND FABRICATION**

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 1. Base: Plastic
  - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 1. Bases: One or more plastic.
  - 2. Vertical Members: Two or more protective-coated-steel channels.
  - 3. Horizontal Member: Protective-coated-steel channel.
  - 4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

## **2.09 PIPE POSITIONING SYSTEMS**

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

## **2.010 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## **2.011 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

## PART 3 - EXECUTION

### 3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- F. 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 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), 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 24 (DN 20 to DN 600), 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 2 (DN 15 to DN 50).
  - 10. Split Pipe-Ring with or without Turnbuckle-Adjustment 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 2-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.

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 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 2 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 20 (DN 65 to DN 500), 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.
- G. 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 20 (DN 20 to DN 500).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. 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.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.



6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb (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.
- J. 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.
- K. 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 absorb 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 absorb 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 absorb 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system 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.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### **3.02 HANGER AND SUPPORT INSTALLATION**

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- 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-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (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.
- O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- Q. Insulated Piping: Comply with the following:
  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 according to 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 inserts.
  6. Insert Material: Length at least as long as protective shield.
  7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.03 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.04 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 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### **3.05 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).

### **3.06 PAINTING**

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529



# SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

### 1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 - PRODUCTS**

### **2.01 EQUIPMENT IDENTIFICATION DEVICES**

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Data:
    - a. Name and plan number.
    - b. Equipment service.
  - 3. Size: 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- C. Access Panel and Door Markers: 1/16-inch- (1.6-mm-) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) center hole for attachment.
  - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### **2.02 PIPING IDENTIFICATION DEVICES**

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
  - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
  - 3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
  - 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  - 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.



### **2.03 DUCT IDENTIFICATION DEVICES**

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

### **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, with numbering scheme approved by Architect. Provide 5/32-inch (4-mm) hole for fastener.
  - 1. Material: 0.032-inch- (0.8-mm-) thick brass.
  - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; beaded chain.

### **2.05 VALVE SCHEDULES**

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
  - 2. Frame: Extruded aluminum.
  - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

### **2.06 WARNING SIGNS AND LABELS**

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## **PART 3 - EXECUTION**

### **3.01 APPLICATIONS, GENERAL**

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

### **3.02 EQUIPMENT IDENTIFICATION**

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  - 1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
  - 2. Heat exchangers, coils, evaporators, heat recovery units, and similar equipment.
  - 3. Fans, blowers, primary balancing dampers, and mixing boxes.
  - 4. Packaged HVAC, central-station AHU and zone-type units.
  - 5. Air Separators, expansion tanks, hydronic specialties.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
  - 1. Letter Size: Minimum 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-fourths the size of principal lettering.
  - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Meters, gages, thermometers, and similar units.
    - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    - e. Fans, blowers, primary balancing dampers, and mixing boxes.
    - f. Packaged HVAC central-station and zone-type units.
- C. Install access panel markers with screws on equipment access panels.

### **3.03 PIPING IDENTIFICATION**

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pre-tensioned pipe markers. Use size to ensure a tight fit.
  2. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch (19 mm) wide, lapped at least 1-1/2 inches (38 mm) at both ends of pipe marker, and covering full circumference of pipe.
  3. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide, lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed 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 non-accessible 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 markers.

### **3.04 DUCT IDENTIFICATION**

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
1. Blue: Supply-air ducts.
  2. Yellow: Return-air ducts.
  3. Letter Size: Minimum 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-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

### **3.05 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; 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:
1. Valve-Tag Size and Shape:
    - a. All services: 1-1/2 inches (38 mm), round.

**3.06 CONCEALED ITEMS ABOVE CEILINGS**

- A. Mark the locations of concealed equipment above ceilings with colored dots, approximately 3/8" diameter, applied to the ceiling directly below the item. Preliminary colors to be used:
  - 1. Green: Domestic plumbing system components.
  - 2. Blue: Heating/cooling system components.
  - 3. Red: Fire Protection components
  - 4. Yellow: Mechanical items not listed above.

**3.07 VALVE-SCHEDULE INSTALLATION**

- A. Mount valve schedule as directed by Owner.

**3.08 ADJUSTING**

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

**3.09 CLEANING**

- A. Clean faces of mechanical identification devices.

END OF SECTION 230553

## **SECTION 230593- TESTING, ADJUSTING, AND BALANCING**

### **PART 1 - GENERAL**

**1.01** A. Section includes testing, adjusting, and balancing of air systems, testing, adjusting, and balancing of hydronic and refrigerating systems, measurement of final operating condition of hvac systems, sound measurement of equipment operating conditions, vibration measurement of equipment of operating conditions.

### **1.02 REFERENCES**

- A. AABC (associated air balance council)-national standards for total system balance.
- B. ASHRAE iii (American Society of Heating, Refrigerating and Air conditioning Engineers).
  - 1. Practices for measurement, testing adjusting and balancing of building, heating, ventilation, air conditioning and refrigeration systems.
  - 2. Tab: testing, adjusting, and balancing. The process of checking and adjusting hvac systems to meet design objective. Basic tab terms used in this section: "chapter, testing, adjusting and balancing" of ASHRAE handbook, latest systems volume.
- C. C. NEBB (national environmental balancing bureau). Procedural standards for testing, adjusting, and balancing of environmental systems.

### **1.03 SUBMITTALS**

- A. A. Test reports: indicate data on AABC national standards for total system balance forms, forms prepared following ASHRAE 111 or NEBB report forms.
- B. B. Field reports: indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- C. C. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
- D. D. Submit draft copies of report for review prior to final acceptance of project. Provide final copies for architect/engineer and for inclusion in operating and maintenance manuals.
- E. E. Provide reports in bound manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- F. F. Include detailed procedures, agenda, sample report forms and a copy of either AABC national project performance guaranty or NEBB certificate of conformance certification prior to commencing system balance.

### **PART 2 - PRODUCTS (NOT APPLICABLE)**

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

Bottineau Ridge II Apartments  
JLG 16098 / ONE 2016446

23 0593 - 1  
TESTING, ADJUSTING AND BALANCING

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
  - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
  - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing. Report deficiencies to the Architect/Engineer and Commissioning Authority.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
  - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 6. Sensors are located to sense only the intended conditions.
  - 7. Sequence of operation for control modes is according to the Contract Documents.
  - 8. Controller set points are set at indicated values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.02 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. 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 AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

### **3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
  - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.



6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
    1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
    2. 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 terminal outlets and inlets without making adjustments.
    1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
  - D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
    1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
    2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.06 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check expansion tank liquid level.
  3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### **3.07 PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage

- heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
  - C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
    1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
  - D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
  - E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
    1. Determine the balancing station with the highest percentage over indicated flow.
    2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
    3. Record settings and mark balancing devices.
  - F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
  - G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

### **3.08 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS**

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### **3.09 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer, model, and serial numbers.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### **3.010 PROCEDURES FOR TEMPERATURE MEASUREMENTS**

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### **3.011 TOLERANCES**

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
  - 2. Air Outlets and Inlets: 0 to minus 10 percent.
  - 3. Heating-Water Flow Rate: 0 to minus 10 percent.
  - 4. Cooling-Water Flow Rate: 0 to minus 5 percent.

### **3.012 REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### **3.013 FINAL REPORT**

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
  - 1. 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, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of TAB firm.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.

9. Signature of TAB firm who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer, type size, and fittings.
  14. Notes to explain why certain final data in the body of reports varies from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outside-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Fan drive settings including settings and percentage of maximum pitch diameter.
    - d. Settings for supply-air, static-pressure controller.
    - e. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
  2. 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.
- F. Fan Coil Unit Test Reports: For air-handling units and heat pumps with coils, include the following:
1. Unit Data: Include the following:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches (mm), and bore.
    - i. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.
  2. Motor Data:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches (mm), and bore.
    - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm (L/s).
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Filter static-pressure differential in inches wg (Pa).
    - f. Preheat coil static-pressure differential in inches wg (Pa).

- g. Cooling coil static-pressure differential in inches wg (Pa).
  - h. Heating coil static-pressure differential in inches wg (Pa).
  - i. Outside airflow in cfm (L/s).
  - j. Return airflow in cfm (L/s).
  - k. Outside-air damper position.
  - l. Return-air damper position.
  - m. Vortex damper position.
- G. 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 (mm), and bore.
    - h. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
  - 2. Motor Data:
    - a. Make and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches (mm), and bore.
    - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
    - g. Number of belts, make, and size.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm (L/s).
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Suction static pressure in inches wg (Pa).
- H. 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 (deg C).
    - d. Duct static pressure in inches wg (Pa).
    - e. Duct size in inches (mm).
    - f. Duct area in sq. ft. (sq. m).
    - g. Indicated airflow rate in cfm (L/s).
    - h. Indicated velocity in fpm (m/s).
    - i. Actual airflow rate in cfm (L/s).
    - j. Actual average velocity in fpm (m/s).
    - k. Barometric pressure in psig (Pa).
- I. Air-Terminal-Device Reports:
- 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Test apparatus used.
    - d. Area served.

- e. Air-terminal-device make.
  - f. Air-terminal-device number from system diagram.
  - g. Air-terminal-device type and model number.
  - h. Air-terminal-device size.
  - i. Air-terminal-device effective area in sq. ft. (sq. m).
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm (L/s).
  - b. Air velocity in fpm (m/s).
  - c. Preliminary airflow rate as needed in cfm (L/s).
  - d. Preliminary velocity as needed in fpm (m/s).
  - e. Final airflow rate in cfm (L/s).
  - f. Final velocity in fpm (m/s).
  - g. Space temperature in deg F (deg C).
- J. 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. Airflow rate in cfm (L/s).
    - b. Entering-water temperature in deg F (deg C).
    - c. Leaving-water temperature in deg F (deg C).
    - d. Water pressure drop in feet of head or psig (kPa).
    - e. Entering-air temperature in deg F (deg C).
    - f. Leaving-air temperature in deg F (deg C).
- K. 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 and serial numbers.
    - f. Water flow rate in gpm (L/s).
    - g. Water pressure differential in feet of head or psig (kPa).
    - h. Required net positive suction head in feet of head or psig (kPa).
    - i. Pump rpm.
    - j. Impeller diameter in inches (mm).
    - 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 (kPa).
    - b. Pump shutoff pressure in feet of head or psig (kPa).
    - c. Actual impeller size in inches (mm).
    - d. Full-open flow rate in gpm (L/s).
    - e. Full-open pressure in feet of head or psig (kPa).

- f. Final discharge pressure in feet of head or psig (kPa).
  - g. Final suction pressure in feet of head or psig (kPa).
  - h. Final total pressure in feet of head or psig (kPa).
  - i. Final water flow rate in gpm (L/s).
  - j. Voltage at each connection.
  - k. Amperage for each phase.
- L. Instrument Calibration Reports:
- 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### **3.014 INSPECTIONS**

- A. Initial Inspection:
- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
  - 2. Randomly check the following for each system:
    - a. Measure airflow of at least 10 percent of air outlets.
    - b. Measure 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. Measure space pressure of at least 10 percent of locations.
    - e. Verify that balancing devices are marked with final balance position.
- B. Final Inspection:
- 1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect and commissioning authority.
  - 2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect and commissioning authority.
  - 3. Architect and commissioning authority shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
  - 4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  - 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
  - 6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

### **3.015 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION



## **SECTION 23 07 00 - HVAC INSULATION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Flexible elastomeric.
    - b. Mineral/glass fiber.
  - 2. Insulating cements.
  - 3. Adhesives.
  - 4. Sealants.
  - 5. Factory-applied jackets.
  - 6. Tapes.
  - 7. Fasteners.
  
- B. Related Sections:
  - 1. Division 7 Section "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items
  - 2. Division 22 Section "Plumbing Insulation."
  - 3. Division 23 Section "Metal Ducts" for duct liners.

#### **1.2 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics per ASTM E84:
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

### **PART 2 - PRODUCTS**

#### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
  
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
  
- C. Flexible Elastomeric:
  - 1. Closed-cell foam, expanded-rubber materials.
  - 2. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 3. Water Vapor Transmission: Not to exceed 0.08 perm-inches when tested in accordance with ASTM E 96 Procedure A.
  
- D. 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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- F. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied 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. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu-in./h-sq. ft.-deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Products: All HVAC insulating products shall be provided by Johns Mansville without exception. (Substitutions: See Section 01 60 00 – Product Requirements)

## **2.2 INSULATING CEMENTS**

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

## **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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
- E. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## **2.4 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.
  - 4. Color: White or gray.
- 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.
  - 4. Color: Aluminum.

## **2.5 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

## 2.7 FASTENERS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
- B. Insulation Pins and Hangers:
  - 1. 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 thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- 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.
  - 2. 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 thick by 1-1/2 inches in diameter.
    - b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - 3. 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 thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive-backed base with a peel-off protective cover.
  - 4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  - 5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

- D. Wire: 0.062-inch soft-annealed, stainless steel.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    - a. For below ambient services, stapling is not permitted.
    - b. Seal seam joints with tape.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, stapling is not permitted.
    - b. Seal seam joints with tape.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
  
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
  
- N. 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 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.

### **3.3 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
  
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
  
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Division 07 Section "Penetration Firestopping" Firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Pipe: Install insulation continuously through floor penetrations.
  3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### **3.4 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.5 MINERAL-FIBER INSULATION INSTALLATION**

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 80 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 80 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.6 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

### 3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated:1
1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  2. Factory-insulated flexible ducts.
  3. Factory-insulated plenums and casings.
  4. Flexible connectors.
  5. Vibration-control devices.
  6. Factory-insulated access panels and doors.

### 3.8 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 non-conditioned space.
  4. Indoor, exposed return located in non-conditioned space.

**Table 1: Typical HVAC Equipment, Piping and Duct Insulation Applications**

HVAC Systems	Insulation Types <sup>(1)</sup>	Density (lbs./cu.Ft.)	Insulation Thickness	Vapor Barrier Requirements <sup>(2)</sup>	Jacket Types <sup>(3)</sup>
Refrigerant Suction piping	FE (closed cell)		1 inch	no	AS
Refrigerant Liquid piping	FE (closed cell)		1 inch	none	none
Condensate Drain Piping	GF	2.5	3/4 inch	Yes	AP
Supply air ducts (common spaces)	GF duct wrap	1.5	1-1/2 inch	yes	FSK <sup>(4)</sup>
Return air ducts (common spaces)	Liner	2.0	1/2 inch	none	<sup>(5)</sup>
Transfer air ducts (all)	Liner	2.0	1/2 inch	none	<sup>(5)</sup>
Exhaust ducts (all)	GF duct wrap	1.5	1-1/2 inch	yes	FSK
Supply air ducts (dwelling units)	None	-	-	-	-
Return air ducts (dwelling units)	Liner	2.0	1/2 inch	none	<sup>(5)</sup>
Exterior piping	refer to application, increase thickness 1/2 inch			yes, SJ	AL or SS
<p>(1) Key to Insulation Materials:            GF = Glass or mineral fiber            CG = Cellular glass            FE = Flexible elastomeric foam            PF = Closed cell phenolic foam            CS = Calcium silicate            HTGF= high temperature glass fiber</p> <p>(2) Key to Vapor Barrier Requirements:            Yes = Required            None = Not required</p>		<p>(3) Key to Jacket Requirements:            AP = All purpose foil, scrim, kraft paper jacket (white).            FSK = Foil, scrim, kraft paper jacket with foil finish.            PVC = PVC jacket.            AL = Aluminum jacket            SS = Stainless steel jacket            GC = Canvas or glass cloth</p> <p>(4) Glass cloth jacket and rigid board insulation required in mechanical rooms and exposed ductwork within 8 feet of floor.</p>			



SJ = continuous sealed joints required

(5) Refer to Section 23 31 13 Metal Ducts for duct liner specification.

**END OF SECTION**



## **SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC**

### **PART 1 - GENERAL**

#### **1.1 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. See Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

#### **1.2 SUBMITTALS**

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
  - 1. Schematic flow diagrams.
  - 2. Power, signal, and control wiring diagrams.
  - 3. Details of control panel faces.
  - 4. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Software and firmware operational documentation.
- D. Operation and maintenance data.

#### **1.3 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### **2.2 CONTROL SYSTEM**

- A. Manufacturers:
  - 1. Alerton Inc.
  - 2. American Auto-Matrix.
  - 3. Honeywell International Inc.; Home & Building Control.
  - 4. 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.

### **2.3 GAS DETECTION EQUIPMENT**

- A. Manufacturers:
  - 1. Ebtron, Inc.
  - 2. Honeywell International Inc.; Home & Building Control.
  - 3. Toxalert, Inc.
  - 4. TSI Incorporated.
  - 5. Vaisala.
  - 6. 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; with 2 factory-calibrated alarm levels at 50 and 100 ppm.
- C. Carbon Monoxide Detection Controllers: Toxalert, Inc. model Gvu-3 controller to monitor carbon monoxide sensors. User adjustable time controller, audible alarm with silence switch, power on/fan on LED's on face of controller, LED to indicate high CO, diesel for each sensor, override switch on face of controller to start fans, contacts to start/stop exhaust fan and open intake motorized damper.
- D. Quantity of sensors to be based on the manufacturer's recommended coverage area.

### **2.4 THERMOSTATS**

- A. Manufacturers:
  - 1. Erie Controls.
  - 2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
  - 3. Heat-Timer Corporation.
  - 4. Honeywell
  - 5. Sauter Controls Corporation.
  - 6. Tekmar Control Systems, Inc.
  - 7. Theben AG - Lumilite Control Technology, Inc.
- B. Space Thermostats:
  - 1. Thermostats shall be of one type for like systems.
  - 2. Thermostats shall have lockout and upper/lower limit temperature setpoint capability.
  - 3. Standalone heat/cool device thermostats shall be Emerson (White Rodgers) model 1F95EZ series capable of auto or manual heat/cool changeover. Thermostats shall have large easy to read digital display with push pad adjustment controls.
  - 4. Common Spaces: Provide electronic programmable thermostats shall be Emerson (White Rodgers) model 1F95 series capable of auto or manual heat/cool changeover. Thermostats shall have digital readout with push pad adjustment controls.
- C. Unit Heater, Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

- D. 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.
- E. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
  - 1. Bulb Length: Minimum 20 feet.
  - 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

## 2.5 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  - 1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
  - 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  - 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
  - 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
  - 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
  - 1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc.
  - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  - 3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
  - 4. Coupling: V-bolt and V-shaped, toothed cradle.
  - 5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  - 6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  - 7. Power Requirements (Two-Position Spring Return): 120-V ac. Coordinate with Division 26.
  - 8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc. Coordinate with Division 26.

9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F.
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
12. Run Time: 12 seconds open, 5 seconds closed.

## **2.6 DAMPERS**

- A. Manufacturers:
  1. Ruskin
  2. TAMCO (T. A. Morrison & Co. Inc.).
- B. Dampers: AMCA-rated, parallel-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
  1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  2. Operating Temperature Range: From minus 40 to plus 200 deg F.
  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 4 cfm per sq. ft. of damper area, at differential pressure of 1-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500.
  5. For low-leakage applications (outside air intake hoods, relief/exhaust air outlet hoods and exhaust fan outlet openings as shown on the drawings), use Tamco Model 9000 SC or Ruskin CDTI-50; there is no equal for these products.

## **2.7 CONTROL CABLE**

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- B. Install labels and nameplates to identify control components according to Division 23.
- C. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- D. Install electronic and fiber-optic cables according to Division 27.
- E. Coordinate exact location of control power transformers and control panels with the Architect/Engineer.

- F. Thermostat located in public areas shall be provided with clear lockable covers unless noted otherwise.
- G. Coordinate required mounting height of thermostats with Architect.

### **3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26.
- C. Install signal and communication cable according to Division 27.
  - 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.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
  - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
  - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 6. Test each system for compliance with sequence of operation.
  - 7. Test software and hardware interlocks.
- B. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

**3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION**



## **SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. See Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
- C. Contractor shall provide a complete automatic temperature control system as specified. Contractor shall provide all 120/240 volt circuits as required to power all low voltage control devices or line voltage devices such as 120 volt damper motor etc.. All wiring shall be provided by this contractor. Electrical Division shall provide all 120/240, 1 phase, line voltage, direct control devices and wiring such as line voltage thermostats, time clocks and switches unless specifically noted to be supplied by this contractor and installed by the Electrical Division or remotely controlled and monitored by a Building Automation system.

#### **1.2 ADJUSTABLE VARIABLES**

- A. Modify software to allow operator adjustment:
  - 1. Parameters
  - 2. Settings
  - 3. Limits
  - 4. Alarm conditions
  - 5. Throttling ranges
  - 6. Deadbands (zero energy bands)
  - 7. Other variables.
- B. Global settings (initial values):
  - 1. Zone Temperature:
    - a. Heating: 72 degrees F. occupied mode, 65 degrees F. unoccupied mode.
    - b. Cooling: 74 degrees F. occupied mode, 80 degrees F. unoccupied mode.
  - 2. Relative Humidity:
    - a. Cooling: 60% maximum.

### **1.3 ABBREVIATIONS**

- A. AHU – air handling unit (includes MAU devices)
- B. DAT – discharge air temperature.
- C. Deg or deg F or degrees – degrees Fahrenheit.
- D. LAT – leaving air temperature (usually after passing through heating or cooling coil).
- E. MA/MAT – mixed air / mixed air temperature (leaving AHU and MAU filter section).
- F. OA/OAT – outside (ambient) air / outside air temperature.
- G. P-I – Proportional and integral control algorithm, controls to setting with zero offset.
- H. RA/RAT – return air / return air temperature.
- I. rh – relative humidity
- J. MAU – roof mounted air conditioning unit
- K. SA/SAT – supply air / supply air temperature.
- L. T – Temperature (degrees Fahrenheit).
- M. VFD – Variable motor speed controller.

### **1.4 OPERATIONAL MODES**

- A. Occupied Mode
  - 1. Maintain zone temperatures at zone temperature settings.
  - 2. Maintain zone humidity at zone humidity settings (where applicable).
  - 3. Maintain ventilation at scheduled minimum ventilation rate unless overridden by economizer cooling.
  - 4. Heating and cooling plants are enabled, activated when called for.
    - a. Remove occupied mode scheduling for Holidays and other one-time events on a global basis and a unit by unit basis. Consult Owner for Holiday occurrences and timeframes.
- B. Unoccupied Mode
  - 1. Occurs when equipment is not in occupied or start-up mode.
  - 2. Unoccupied mode begins when the occupied mode ends and continues until the optimal start control initiates start-up mode.

3. Close outside air (ventilation) dampers.
4. Maintain spaces at (or above) setback temperature settings when O.A. temperatures are below occupied settings. Allow temperature drift.
5. Maintain spaces at (or below) setup temperature and humidity settings when O.A. temperatures are above occupied settings. Allow temperature drift.

C. Start-up Mode

1. Occurs prior to occupied mode. Optimal start control commands each system to reach occupied mode conditions while outside air dampers remain closed.

D. Safety and Unit Protection

1. Smoke Detectors: If either the smoke detector located at the supply air discharge or at the return air inlet of the unit senses the presence of smoke, then the air-handling system, including all associated exhaust fans, shall shut off. Smoke detectors shall be automatically reset.
2. Supply Fan Discharge Static Pressure High Limit: A high limit pressure control shall stop the supply fan if the static pressure at the fan discharge exceeds the setpoint. The pressure sensing element shall be located two-thirds of the way down the supply main. Initial setpoint: 2.5 inches w.c. (adj.) positive pressure. The high limit pressure switch shall be manually reset.
3. Temperature Low Limit: Freezestat serpentine across the upstream face of the cooling coil shall provide an alarm signal if any one foot of the sensing element falls below 38°F (adj.). The air-handling system, including all associated exhaust fans, shall shut off. The freezestat shall be manually reset.

## 1.5 SYSTEM MONITORING REQUIREMENTS

A. Monitor and log the input data and status of the listed devices and the HVAC equipment where sequences of operation are specified.

1. Create trend logs for representative equipment to demonstrate this functionality.
2. Log the data with side-by-side comparisons to the settings to be maintained.
3. Display the results graphically for user programmable time periods.
4. Provide memory and storage capability to save two weeks of complete trend data.
5. Delete oldest data to save new data upon reaching capacity of the available memory.

B. Monitor the following points for inclusion in trend logs and graphic displays:

1. Temperature sensors.
2. Humidity sensors.
3. Airflow measuring stations.

4. VFD output signals.
5. Damper actuator positions.
6. Timestamp and log source of unoccupied override commands from VAV zones.
7. Alarm conditions.
8. General fault signals from digital controls such as from a VFD.

## **1.6 FAN COIL UNITS**

### **A. FCU-1.**

1. Operate fan continuously. Modulate hot water control valve to maintain 70°F (Adj.) discharge air setpoint.
2. Provide safeties as listed elsewhere in this specification.

### **B. FCU-2.**

1. Provide a programmable thermostat with fan/off/auto switch and unoccupied/occupied settings. Provide 2-position control valve. The space thermostat shall cycle the condensing unit or open the control valve to maintain setpoint. The fan shall be allowed to run continuous or cycle depending on thermostat setting. Coordinate thermostat stages with applicable condensing unit stages (refer to equipment schedule).

### **C. FCU-3.**

1. Provide a programmable thermostat with fan/off/auto switch and unoccupied/occupied settings. Provide 2-position control valve. The space thermostat shall cycle the condensing unit or open the control valve to maintain setpoint. The fan shall be allowed to run continuous or cycle depending on thermostat setting. Coordinate thermostat stages with applicable condensing unit stages (refer to equipment schedule).

### **D. FCU-4.**

1. Provide a programmable thermostat with fan/off/auto switch and unoccupied/occupied settings. Provide 2-position control valve. The space thermostat shall cycle the condensing unit or open the control valve to maintain setpoint. The fan shall be allowed to run continuous or cycle depending on thermostat setting. Coordinate thermostat stages with applicable condensing unit stages (refer to equipment schedule).

## **1.7 BOILERS (B-X):**

- A. Provide all line and low voltage control wiring for the boiler plant. This includes providing outdoor temperature sensor, wiring the outdoor reset boiler control system and all safeties, etc. Coordinate with the boiler vendor for all necessary wiring.

1. Outdoor Reset Schedule:
  - a. Max boiler HWS temp: When OA = -16°F, HWS = 180° F

- b. Min boiler HWS temp: When OA = 55°F, HWS = 140° F
- B. The boiler panel automatically calculates a linear regression for all temperatures in between.
  - 1. Boiler Circulating Pumps shall be wired to boiler panel contacts.
  - 2. Provide pump sequencer Tekmar D132 or equivalent built-in boiler controls capable of providing automatic lead/lag control and warm weather shutdown. Boiler and pump(s) OA temperature start up setpoint shall be coordinated and programmed for the same setting.
  - 3. Control panel shall also be capable to providing control of boiler plant for domestic hot water generation. See boiler specification for more information.
- C. Emergency Boiler Shut Down: Provide an emergency shut off switch at the main boiler room door to shut off the fuel and permit any burner(s) to cycle through its post-purge sequence when the switch is activated.

## **1.8 EXHAUST FAN SEQUENCES**

- A. Toilet Room Exhaust Fans
  - 1. Low speed: Continuous
  - 2. High speed: Interlock of fan operation with room light switch.
- B. Parking Ventilation Fans (EF and associated intake motorized dampers)
- C. Provide a carbon monoxide CO monitoring system (ACME, Macurco, ToxAlert, Honeywell, CET) for controlling the garage exhaust and make-up air. Provide additional sensors if required for appropriate coverage. Vendor shall provide quarterly calibration for the first year of operation. Provide line voltage as required to power controller(s).
  - 1. Input Devices:
    - a. Wall-mounted, field-wired temperature sensor.
    - b. Wall-mounted, field-wired carbon monoxide sensor.
  - 2. Operating Modes:
    - a. Ventilation mode:
      - 1) Energize fan upon detection of carbon monoxide.
      - 2) Energize fan upon a rise of space temperature above 85 deg F (adj.).
- D. Ventilation Fans (EF-2)
  - 1. Input Devices:
    - a. Wall-mounted, field-wired temperature sensor.
  - 2. Operating Modes:
    - a. Ventilation mode:
      - 1) Energize fan upon a rise of space temperature above 85 deg F (adj.).

- E. Trash Room Exhaust Fans
  - 1. Exhaust fans to operate continuously. Manufacturer provided disconnect for fan service only.

**1.9 MISCELLANEOUS CONTROL**

- A. Elevator Shaft Vent Damper Control.
  - 1. A motor-operated damper shall open when signaled by the fire alarm system, or from a key-operated switch in the elevator lobby.
  - 2. The damper operator shall be an electric or electronic, two-position operator, normally-closed.
  - 3. Power and signal (120 vac) by this Contractor.
- B. Finned Tube Radiation
  - 1. Provide 24 volt control valve and remote mounted space thermostat. Thermostat shall have capabilities to set high and low temperature setpoints using limiting pins. Danfoss RA2000 or equal.
- C. Unit Heater Control.
  - 1. Wall mounted, line voltage thermostats installed by this Contractor. Flow shall be continuous through heater coil. Furnish line voltage thermostat. Fan shall cycle to satisfy space temperature. Electrical Division shall install all 120/240, 1 phase, line voltage, direct control devices and wiring such as line voltage thermostats, time clocks and switches unless specifically noted to be remotely controlled and monitored by a Building Automation system.
- D. Sump Pump Control.
  - 1. Pump(s) shall operate on control package supplied with the pumps.
- E. Water Softener Control.
  - 1. Softener(s) shall operate on control package supplied with the softeners.
- F. Cabinet Unit Heater Control.
  - 1. Wall mounted, low voltage, thermostats installed by this Contractor.
- G. Split System Control.
  - 1. Wall mounted, low voltage, thermostats installed by the equipment manufacturer.
- H. Furnace Control.
  - 1. Wall mounted, low voltage, thermostats installed by this Contractor. Unit shall operate on its internal controls.
- I. Thru the wall Air Conditioning Units

1. Wall mounted, low voltage, thermostats installed by this Contractor. Unit shall operate on its internal controls. Interlock motorized damper on outside air intake with fan operation.

J. Water Heater Control.

1. Water heater shall operate on its internal controls.

K. Plumbing Pump Control.

1. Cycle pump based on aquastat. In hand mode, run pump continuously.

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

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

**END OF SECTION**





# SECTION 231123 - FACILITY NATURAL-GAS 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. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.

### 1.3 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.

### 1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig (450 kPa) minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and is reduced to secondary pressure of 0.5 psig (3.45 kPa) or less.

### 1.5 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.
  6. Mechanical sleeve seals.
  7. Escutcheons.
- B. 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.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

#### **1.6 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.

#### **1.7 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.

#### **1.8 PROJECT CONDITIONS**

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than seven days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Owner's written permission.

## 1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

### 2.1 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.
  6. Mechanical Couplings:
    - a. Stainless-steel or Steel flanges and tube with epoxy finish.
    - b. Buna-nitrile seals.
    - c. Stainless-steel or Steel bolts, washers, and nuts.
    - d. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    - e. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Galvanized pipe can be used on exterior gas piping only.
- C. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.

1. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
  2. 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.
  3. 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.
  4. Striker Plates: Steel, designed to protect tubing from penetrations.
  5. 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.
  6. Operating-Pressure Rating: 5 psig (34.5 kPa).
- D. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K (ASTM B 88M, Type A) or ASTM B 88, Type L (ASTM B 88M, Type B).
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 (ASTM B 88M, Type A) or ASTM B 88, Type L (ASTM B 88M, Type B).
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.

## 2.2 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).
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
  2. Nitrile seals.
  3. Hand operated with automatic shutoff when disconnected.
  4. For indoor or outdoor applications.
  5. Adjustable, retractable restraining cable.
- C. 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig (862 kPa).
- D. 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-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig (862 kPa).
- E. 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-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
  4. CWP Rating: 750 psig (5170 kPa).
- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

### **2.3 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.

## 2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "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 (862 kPa).
  - 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 (862 kPa).
  - 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. Body: Bronze, complying with ASTM B 584.
  - 2. Ball: Chrome-plated brass.
  - 3. Stem: Bronze; blowout proof.
  - 4. Seats: Reinforced TFE; blowout proof.
  - 5. Packing: Separate packnut with adjustable-stem packing threaded ends.
  - 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 7. CWP Rating: 600 psig (4140 kPa).
  - 8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 9. 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. Body: Bronze, complying with ASTM B 584.
  - 2. Ball: Chrome-plated bronze.
  - 3. Stem: Bronze; blowout proof.
  - 4. Seats: Reinforced TFE; blowout proof.
  - 5. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 7. CWP Rating: 600 psig (4140 kPa).

8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Bronze Plug Valves: MSS SP-78.
1. Body: Bronze, complying with ASTM B 584.
  2. Plug: Bronze.
  3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  4. Operator: Square head or lug type with tamperproof feature where indicated.
  5. Pressure Class: 125 psig (862 kPa).
  6. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. Body: Cast iron, complying with ASTM A 126, Class B.
  2. Plug: Bronze or nickel-plated cast iron.
  3. Seat: Coated with thermoplastic.
  4. Stem Seal: Compatible with natural gas.
  5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  6. Operator: Square head or lug type with tamperproof feature where indicated.
  7. Pressure Class: 125 psig (862 kPa).
  8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- H. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Body: Cast iron, complying with ASTM A 126, Class B.
  2. Plug: Bronze or nickel-plated cast iron.
  3. Seat: Coated with thermoplastic.
  4. Stem Seal: Compatible with natural gas.
  5. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  6. Operator: Square head or lug type with tamperproof feature where indicated.
  7. Pressure Class: 125 psig (862 kPa).
  8. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- I. Valve Boxes:
1. Cast-iron, two-section box.
  2. Top section with cover with "GAS" lettering.
  3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
  4. Adjustable cast-iron extensions of length required for depth of bury.
  5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

## 2.5 **MOTORIZED GAS VALVES**

- A. Automatic Gas Valves: Comply with ANSI Z21.21.
  - 1. Body: Brass or aluminum.
  - 2. Seats and Disc: Nitrile rubber.
  - 3. Springs and Valve Trim: Stainless steel.
  - 4. Normally closed.
  - 5. Visual position indicator.
  - 6. Electrical operator for actuation by appliance automatic shutoff device.
  
- B. Electrically Operated Valves: Comply with UL 429.
  - 1. Pilot operated.
  - 2. Body: Brass or aluminum.
  - 3. Seats and Disc: Nitrile rubber.
  - 4. Springs and Valve Trim: Stainless steel.
  - 5. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
  - 6. NEMA ICS 6, Type 4, coil enclosure.
  - 7. Normally closed.
  - 8. Visual position indicator.

## 2.6 **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. Service Pressure Regulators: Comply with ANSI Z21.80.
  - 1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
  - 2. Springs: Zinc-plated steel; interchangeable.
  - 3. Diaphragm Plate: Zinc-plated steel.
  - 4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
  - 5. Orifice: Aluminum; interchangeable.
  - 6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  - 7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
  - 8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
  - 9. Overpressure Protection Device: Factory mounted on pressure regulator.
  - 10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  - 11. Maximum Inlet Pressure: 100 psig (690 kPa).
  
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
  - 1. Body and Diaphragm Case: Cast iron or die-cast aluminum.



2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 2 psig (13.8 kPa).

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 2 psig (13.8 kPa).

**2.7 DIELECTRIC FITTINGS**

- A. Comply with applicable requirements in Division 23 Section " Common Work Results For HVAC."

**2.8 SLEEVES**

- A. Comply with applicable requirements in Division 23 Section " Common Work Results For HVAC."

**2.9 MECHANICAL SLEEVE SEALS**

- A. Comply with applicable requirements in Division 23 Section " Common Work Results For HVAC."

**2.10 ESCUTCHEONS**

- A. Comply with applicable requirements in Division 23 Section " Common Work Results For HVAC."

**2.11 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**

### **3.1 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.

### **3.2 PREPARATION**

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code 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.

### **3.3 OUTDOOR PIPING INSTALLATION**

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. 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.
- C. 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.
- D. Install fittings for changes in direction and branch connections.
- E. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

- F. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- G. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### **3.4 INDOOR PIPING INSTALLATION**

- A. Comply with NFPA 54 and 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. Install escutcheons at penetrations of interior walls, ceilings, and floors.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. 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.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. 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.
- R. 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 Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
  4. 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.
  5. 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.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. 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.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### **3.5 SERVICE ENTRANCE PIPING**

- A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.

1. Exterior fuel gas distribution system piping upstream of meter, service pressure regulator, and service meter will be installed by gas utility.

### **3.6 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.

### **3.7 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 "Braze 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.

### **3.8 HANGER AND SUPPORT INSTALLATION**

- A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

### **3.9 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 Division 23 Section "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. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (flat).
    - d. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### **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 and 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. 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 Drawn-temper copper tube with wrought-copper fittings and brazed joints.
  4. Galvanized pipe can be used on exterior gas piping only.
- B. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

### **3.14 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, copper tube with wrought-copper fittings and brazed joints.
  3. 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.

### **3.15 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 or lubricated 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 231123



## **SECTION 232113 - HYDRONIC PIPING**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. This Section includes piping, special-duty valves, and hydronic specialties.
  - 1. Hot-water heating piping.
  - 2. Makeup-water piping.
  - 3. Condensate-drain piping.
  - 4. Air-vent piping.
  - 5. Safety-valve-inlet and -outlet piping.
- B. This Section includes flushing and cleaning of piping systems. All flushing and cleaning procedures shall be accomplished for all piping systems prior to systems being placed into operation.
- C. Provide glycol feed system as described in this Section.
- D. Related Sections include the following:
  - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

#### **1.03 SUBMITTALS**

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, and automatic flow-control valves.
- B. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Failed test results and corrective action taken to achieve requirements.
- C. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 01.
- D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site. All water analysis and reports shall be accomplished prior to systems being placed into operation.
  - 1. Water analysis prior to chemical treatment.
  - 2. Water analysis after chemical treatment for all piping systems.

3. Signed report by Chemical Treatment supplier.
  4. Provide water analysis at 1 month, 6 month and 1 year of initial operation of system.
- E. If a dirty system exists after the system is placed into operation, the responsibility to reflush and clean the system as described later in this specification, and clean all strainers, until a clean system is provided, will be the responsibility of the mechanical contractor. A new water analysis performed by an independent third party consultant will be required as proof of a clean system. Mechanical contractor will be responsible for all costs related to a dirty system including Architect-Engineering fees to witness the reflushing of the system.

#### **1.04 QUALITY ASSURANCE**

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.

#### **1.05 COORDINATION**

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.
- E. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.
- F. Coordinate installation of pipe sleeves for penetrations through wall and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Penetration Firestopping" for fire and smoke wall and floor assemblies.

## **PART 2 - PRODUCTS**

#### **2.01 PIPING MATERIALS**

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

## **2.02 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).
- B. DWV Copper Tubing: ASTM B 306, Type DWV (for nonpressure applications only).
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- F. Press Fitting: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Viega, 17545 Daleview Dr., Lakewood, OH 44107, 877-620-0016; or Ridge Tool Company, 400 Clark Street, Elyria, OH 44035, 800-519-3456. Apollo Xpress 1255 Oak St. Elkhart, IL, 800-284-4851.
- G. Press Connections: Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.
- H. Copper Grooved-End Fittings, NPS 2 to NPS 8: Copper-tube dimensions, ASTM B75 or ASTM B152 wrought copper tube or ASTM B584-87 bronze castings. (Flaring tube or fitting ends to IPS dimensions is not permitted).
  - 1. Copper-Tubing, Keyed Couplings: Copper-tube dimensions. Include ASTM A395 and A536 ductile iron, offsetting, angle-pattern bolt pad housing sections, EPDM synthetic rubber gasket suitable for the intended service up to +250 deg F, and bolts and nuts. Coupling housings coated with copper colored alkyd enamel.
  - 2. Grooved Flange Adapter: Copper tube dimensioned, flat face, ductile Iron housing coated with copper-colored enamel to accommodate pressure rating up to 300-psig.

## **2.03 STAINLESS STEEL PIPE AND FITTINGS**

- A. Stainless Steel Piping: ASTM A312, Type 304/304L, Schedule 10S, full finish annealed pipe.
- B. Stainless Steel Pressure-Seal Fittings: Precision cold drawn stainless steel housing, with synthetic rubber O-ring seals, EPDM, pipe stops and pressure-sealed end connections.

## **2.04 STEEL PIPE AND FITTINGS**

- A. Steel Pipe, NPS 3/4 through NPS 2 (DN 20 through DN 50): ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade A, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 through NPS 12 (DN 65 through DN 300): ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends.
- C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.

- D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- H. 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.
- I. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
- J. Grooved Mechanical-Joint Couplings NPS 2 to NPS 12: Ductile-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
  - 1. Rigid Type: Housings shall be cast with offsetting, angle-bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9.
    - a. NPS 2 to NPS 8: Couplings designed for direct "stab" installation without field disassembly, with Grade "EHP" EPDM gasket, -30 deg F to +250 deg F temperature rating.
  - 2. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.
    - a. NPS 2 to NPS 8: "Installation Ready" couplings designed for direct "stab" installation without field disassembly, with Grade "EHP" EPDM gasket, -30 deg F to +250 deg F temperature rating. "
    - b. NPS 10 and NPS 12: Standard flexible coupling with Grade "E" EPDM gasket, -30 deg F to +230 deg F temperature rating.
- K. Flange-Adapters: Ductile iron casting, flat faced, designed for incorporating flanged components with ANSI Class 125 and 150 bolt-hole patterns to a grooved piping system.
- L. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 220 deg F (184 deg C) and pressures up to 150 psig (1035 kPa).
- M. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- N. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

- O. Grooved Joint Lubricants: Lubricate gaskets in accordance with the manufacturer's recommendations with lubricant supplied by the coupling manufacturer that is suitable for the gasket elastomer and system media.

## 2.05 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "HVAC Instrumentation and Controls."
- C. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- D. Pressure-Reducing Valves: Diaphragm-operated, bronze or brass body with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.
- E. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.
- F. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
  - 1. NPS 2 (DN 50) and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded, or solder-joint ends.
  - 2. NPS 2 (DN 50) and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
  - 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.
- G. Automatic Flow-Control Valves: Factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:
  - 1. Gray-iron or brass body, designed for 175 psig (1206 kPa) at 200 deg F (93 deg C) with stainless-steel piston and spring.
  - 2. Brass or ferrous-metal body, designed for 300 psig (2068 kPa) at 250 deg F (121 deg C) with stainless-steel piston and spring.
  - 3. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig (2067 kPa) at 250 deg F (121 deg C).
  - 4. Brass or ferrous-metal body designed for 400 psig (2757 kPa) at 225 deg F (107 deg C) with brass or polyphenylsulfone orifices with elastomeric diaphragm.
  - 5. The manufacturer, for a period of one year from shipment of valves, shall exchange up to 10 percent of the internal flow cartridges at no charge, if flow changes on coils are made.
  - 6. Manufacturers:
    - a. Griswold
    - b. Bell & Gossett

c. Flow Design Inc.

- H. Pump Discharge Valves: 175 psig maximum working pressure, 250 deg F maximum operating temperature, cast-iron or ductile iron body, replaceable bronze disc with EPDM seat insert, bronze seat, stainless steel stem and spring, and "Teflon" packing. Valves shall have NPT, grooved or flanged connections and straight or angle pattern. Features shall include non-slam check valve with spring-loaded weighted disc, pressure taps, and calibrated adjustment feature to permit regulation of pump discharge flow, shutoff and valve design to permit repacking under full system pressure.
- I. Tri-Service Valve Assembly: In lieu of triple duty valves, install Victaulic Tri-Service valve assembly at pump discharge. Valve shall provide shut-off, throttling, and non-slam check service in one unit. Straight pattern, 300 psig pressure rating, Vic-300 MasterSeal™ butterfly valve assembled with Series 779 Venturi check valve with flow measurement capabilities and Victaulic couplings (style to be determined by system requirements). For NPS 14 thru NPS 24 sizes Vic-300 AGS butterfly valve and Series W715 dual disc design check valve assembly, assembled with AGS "W" Series couplings, with 230 psig pressure rating.

**2.06 HYDRONIC SPECIALTIES**

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 240 deg F (116 deg C) operating temperature; with NPS 1/4 (DN 8) discharge connection and NPS 1/2 (DN 15) inlet connection.
- C. Provide where indicated an automatic by-pass valve Danfoss model AVDO. Valve shall be self-acting to maintain minimum flow rates. Valve shall open upon a rise in differential pressure with a setting range of 0.725-7.25 psi capable of 145 psi working pressure and 248° F maximum flow temperature. Valve shall be available with NPT or solder tail ends.
- D. Expansion Tanks: Welded carbon steel, rated for 125-psig (860-kPa) working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.
- E. Air and Dirt Separators: Provide either of the following combination air and dirt:
  - 1. Turbulence Suppressive Coalescing Type Air and Dirt Separators: Welded black steel; constructed for 150 psig (1035 kPa) maximum working pressure and 270 deg F (132 deg C) maximum operating temperature; less than 1 foot of water pressure drop and velocity not to exceed 4 feet per second; integral copper bundle of tubes designed as the turbulence suppressive coalescing medium to remove free and entrained air during start-up and to continue to eliminate dissolved air and dirt through continual circulation; separate air and venting chambers; integral float actuated brass air vent; valved side tap to flush floating dirt; blowdown connection and valve; flanged or threaded connections. Spirotherm Spirovent Dirt, Taco series 4900, Bell & Gossett CSRS or equal.

- F. Bypass Feeders: Cast iron or steel, for introducing chemicals into system; with funnel shutoff valve on top, air-release valve on top, drain valve on bottom, and recirculating shutoff valves on sides.
1. JL Wingert Filter –Feeder with filter, 5 Gallon capacity, and 200 PSI rating or equal.
  2. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
  3. Closed-Loop System: One bypass feeder on each system with isolating and drain valves.
    - a. Introduce chemical treatment through bypass feeder when required or indicated by test.
- G. Y-Pattern Strainers: 300 psig (2068 kPa) or 125-psig (860-kPa) working pressure; ductile-iron (ASTM A 536) or cast-iron body (ASTM A 126, Class B), flanged or grooved ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, 1/16-inch (2 to 3 4-inch pipe size), 1/8-inch (greater than 3 4-inch pipe size) perforated stainless-steel basket, and bottom drain connection.
- H. Y-Pattern Strainers: 300 psig (2068 kPa) working pressure; ductile-iron (ASTM A 536) body, grooved ends, bolted cover, 0.156-inch diameter perforation (14 to 18 inch pipe size), perforated stainless-steel basket and bottom drain connection.
- I. Basket Strainers: 125-psig (860-kPa) working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, 1/8-inch perforated stainless-steel basket, and bottom drain connection.
- J. Pump Suction Diffusers: Ductile-iron body, with threaded connections for 2 inch and smaller, flanged or grooved connections for 2-1/2 inch and larger; 175 psig working pressure, 230 deg F maximum operating temperature; and complete with the following features:
1. Inlet vanes with length 2-1/2 times pump suction diameter or greater.
  2. Cylinder strainer with 5/32 inch diameter openings with total free area equal to or greater than 5 times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head.
  3. Disposable fine mesh strainer to fit over cylinder strainer.
  4. Permanent magnet, located in flow stream, removable for cleaning.
  5. Adjustable foot support, designed to carry weight of suction piping.
  6. Blowdown tapping in bottom; gage tapping in side.
  7. Type 304 stainless steel 20-mesh, startup pre-filter.
- K. Propylene Glycol:
1. The heat transfer fluid must be an industrial quality, corrosion inhibited fluid, prepared from a concentrate consisting of at least 95% Ethylene.
  2. Only deionized water can be used for dilution of the heat transfer fluid. Softened water cannot be used for dilution.
  3. The fluid must be designed to provide a minimum 10-year service life when properly installed and maintained.
  4. The corrosion inhibitor must be formulated and blended by the manufacturer. Inhibitors added in the field or by distributors are not acceptable.
  5. The product must pass the ASTM D1384 glassware corrosion test.
  6. The fluid must not be automotive antifreeze or any other formulation that contains silicates.
  7. The product must be dyed to facilitate the detection of leaks and the presence of other fluids in the system.
  8. The fluid must be equipped with an anti-foaming agent to minimize air entrainment.

9. The fluid manufacturer must offer a testing service to annually determine critical properties of the fluid. This service must be complimentary for systems containing at least 250 gallons of concentrated fluid, for example, 1000 gallons of 30% propylene glycol solution.
10. Analysis must include, as a minimum, determination of the following properties.
  - a. Glycol content/freeze point
  - b. pH/reserve alkalinity
  - c. Inhibitor levels
  - d. Solids
  - e. Corrosion products
  - f. Contaminants
11. Glycol shall be premixed with water from manufacturer/supplier to a 30% solution with the contractor providing an analysis at substantial completion, 6 months and 11 months to confirm properties of fluid.

## **PART 3 - EXECUTION**

### **3.01 PIPING APPLICATIONS**

- A. Hot Water, NPS 4 and Smaller: Type L, hard copper tubing with grooved mechanical-joint couplings, soldered joints or press-fit connections; Schedule 40 steel pipe with threaded joints, welded and flanged joints or grooved mechanical-joint couplings.
- B. Hot Water, NPS 2 and Smaller: ASTM A312, Type 304/304L, Schedule 10S, full finish annealed pipe, pressure-sealed connections.
- C. Hot Water, NPS 5 and Larger: Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.
- D. Condensate Drain Lines: Type DWV copper tubing with soldered joints.

### **3.02 VALVE APPLICATIONS**

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
  1. Shutoff Duty: Ball and butterfly valves.
  2. Throttling Duty: Globe, ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- C. Install automatic flow control valves as indicated in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
- D. Install automatic flow control valves in the return water line of each chilled beam.



- E. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- F. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor drain. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01, for installation requirements.
- G. Install pressure-reducing valves on chilled water and heating systems and elsewhere as required to regulate system pressure.
- H. Install all control valves and accessories furnished by the temperature control contractor. Coordinate these requirements with the successful temperature control.

### **3.03 PIPING INSTALLATIONS**

- A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping installation requirements.
- B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. 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.
- D. Install hydronic piping level. Install condensate piping at a uniform grade of 1/8 inch per foot downward in the direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers.
- H. Anchor piping for proper direction of expansion and contraction. Refer to Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for requirements.
- I. Grooved Joints: The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
- J. Pressure-Sealed Joints: Pipe shall be square cut, +/- 0.030", properly deburred and cleaned to ensure leak-tight O-ring seal. Pipe ends shall be marked at the required location, using a manufacturer-supplied gauge, to ensure full insertion into the coupling or fitting during assembly. Use a tool with the proper sized jaw for pressing.

### **3.04 HANGERS AND SUPPORTS**

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

### **3.05 PIPE JOINT CONSTRUCTION**

- A. Refer to Division 23 Section "Common Work Results for HVAC" for joint construction requirements for soldered joints in copper tubing; threaded, welded, and flanged joints in steel piping.

### **3.06 HYDRONIC SPECIALTIES INSTALLATION**

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required and as detailed for system air venting.
- B. Install automatic air vents in mechanical equipment rooms only at high points of system piping.
- C. Install air separator in pump suction lines. Install a horizontal tee fitting (side mounted) on main piping and run piping to expansion tank. Install as detailed on the drawings.
- D. Install expansion tanks on floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system design requirements.
  - 1. Support tank from structure with sufficient strength to carry weight of tank, piping connections, and fittings, plus weight of a full tank of water. Do not overload building components and structural members.

### **3.07 TERMINAL EQUIPMENT CONNECTIONS**

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure and temperature gages at coil inlet connections.

### **3.08 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 system with clean water. Clean strainers.
  - 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 trapped air. Use drains installed at low points for complete draining of liquid.
  3. Check expansion tanks to determine that they are not air bound and that system is full of water.
  4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design 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 either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of 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.

### **3.09 ADJUSTING**

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
1. Open valves to fully open position. Close coil bypass valves.
  2. Check pump for proper direction of rotation.
  3. Set automatic fill valves for required system pressure.
  4. Check 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. Check operation of automatic bypass valves.
  7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
  8. Lubricate motors and bearings.

### **3.010 FLUSHING AND CLEANING PIPING SYSTEMS**

- A. Notification: Notify Engineer 48 hours in advance of the beginning of the cleaning process. The cleaning process will not be deemed acceptable unless witnessed and approved by the Engineer or Engineer's representative.
- B. All piping systems shall be flushed and cleaned.

C. Hot Water Piping System inside and outside the building: Clean system as specified in this section.

1. General: Perform the following for each step as outlined below:
  - a. Fill the system by bypassing the water make-up pressure reducing valve with all system air vents open. After filling, close all air vents. Check air vents in sequence to bleed off any trapped air, ensuring circulation through all piping sections of the system.
  - b. Remove mesh screens from all strainers except pump suction diffusers. Check suction diffusers and/or strainers at pumps frequently, and clean as often as needed.
  - c. Run system pumps in parallel to maximize flushing of the system.
  - d. Flush until clean as approved by the Engineer of record.
2. Step 1: Initial flushing.
  - a. Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damaging any of the hydronic system components. Provide temporary piping or hoses to bypass boilers, coils, cooling tower, and other hydronic equipment unless an acceptable means of protection are provided. The "acceptable means" will have to be approved by the Engineer.
  - b. If possible, sectionalize system to obtain a debris carrying velocity of 6 feet per second (1.8 m/s).
  - c. Connect all dead-end supply and return headers as necessary, and as shown on the details. Flush bottom of risers using the system low point drain valves. Install temporary piping main strainers where necessary to protect down-stream equipment.
  - d. Provide temporary hose, temporary and/or permanent piping, and booster pump(s) as needed to accomplish flushing of hydronic system. No chemicals or detergents shall be used during initial flushing. Drain and prepare for cleaning.
3. Step 2: Cleaning.
  - a. Contractor to temporarily pipe all systems so that the installed boiler can be utilized for heating loops. At the contractors option a temporary boiler can be utilized in lieu of temporary piping connections.
  - b. Provide an alkaline phosphate or non-phosphate detergent/surfactant/specific to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe compounds, iron oxide, and similar deleterious substances. The cleaning agent can be used with or without inhibitor, and shall be suitable for use on wetted metals. A 1% or 2% solution of trisodium phosphate (TSP), or other recognized low foaming, alkaline detergent cleaner is an acceptable cleaning agent.
  - c. Circulate cleaning solution throughout the system, with controls temporarily adjusted to raise the solution temperature to a minimum of 105F. Alternate operation of the primary and standby pumps and circulate the warm solution for a minimum of 6 hours. Then turn off the boiler and pump, completely drain the system, and refill with fresh water. Repeat the cleaning process only if there is indication of foreign matter still in the system or if a test of the water indicates that it is slightly acid.
  - d. Circulate the system to remove organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by the initial flushing (flushing without chemicals).
  - e. Keep isolated equipment which is "clean", and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 6 feet per second (1.8 m/s).
  - f. Drain and prepare for final flushing.

4. Step 3: Final Flushing.
  - a. Flush all dead ends and operate all valves to dislodge any debris in valve body by throttling velocity.
  - b. Flush system until all cleaning solution and cleaning compounds have been displaced by clean make-up water, but not for less than one hour. No chemicals or detergents shall be used during final flushing.
  - c. After final flushing is completed, make final connections to isolated equipment.

D. System Filling:

1. After final flushing, close and fill the systems as soon as possible after final flushing to minimize corrosion.
2. Provide chemical treatment and water quality analysis and submit to the A/E.

END OF SECTION 232113



# SECTION 233113 - METAL DUCTS

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round and flat-oval ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Duct liner.
  - 5. Sealants and gaskets.
  - 6. Hangers and supports.
- B. Related Sections:
  - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

### 1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.
  - 1. Static-Pressure Classes:
    - a. Supply Ducts (Upstream from Air Terminal Units): 3-inch wg.
    - b. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
    - c. Supply Ducts (in Mechanical Equipment Rooms): 3-inch wg.
    - d. Return Ducts (Negative Pressure): 1-inch wg.
    - e. Exhaust Ducts (Negative Pressure serving exhaust on FCU's): 3-inch wg.
    - f. Exhaust Ducts (Negative Pressure serving exhaust fans): 1-inch wg.
  - 2. Leakage Class:
    - a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa).
    - b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa).

- c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg (0.29 L/s per sq. m at 250 Pa).
- d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg (0.29 L/s per sq. m at 250 Pa).

#### **1.04 SYSTEM DESCRIPTION**

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect-Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.
- B. As the Mechanical drawings are of small scale, it is not possible to show all necessary offsets, fittings, and accessories. Examine General Construction, Mechanical, and Electrical Drawings and Specifications; obtain exact locations, measurements, levels, etc., at the site; arrange systems accordingly; and, at no additional expense to the Owner, furnish fittings, offsets, and accessories as required.

#### **1.05 QUALITY ASSURANCE**

- A. NFPA Compliance:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

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

- A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.
- C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

## **PART 2 - PRODUCTS**

### **2.01 SHEET METAL MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.



- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- D. Stainless Steel: ASTM A 480/A 480M, Type 304 or 316, and having a No. 2D finish for concealed ducts and No. 4 finish for exposed ducts.
- E. Aluminum Sheets: 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.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- G. 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).

## **2.02 SEALANT MATERIALS**

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- C. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- D. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- E. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
- F. EPDM rubber gasket, held in place with a 180° hemmed edge, that provides a reliable, airtight seal. Design must meet or exceed SMACNA's Class 3 for leakage (-20 inches wg to +20 inches wg).

## **2.03 HANGERS AND SUPPORTS**

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached. **DO NOT ATTACH DUCT TO METAL ROOF DECK.**
  - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
  - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
- E. Roof Duct Supports:
1. Manufacturers:
    - a. B-Line
    - b. Pipe Pier
    - c. Industrial Commercial Services

#### **2.04 DUCT LINER FOR DUCTWORK**

- A. Provide closed cell elastomeric sheet insulation as manufactured by AP/Armaflex or equal. Insulation is 1" thick and meet all the requirements of ASTM, NFPA and UL.
- B. Install liner per manufacturers recommendation in locations indicated on the drawings.

#### **2.05 RECTANGULAR DUCT FABRICATION**

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
  3. Provide a complete system including interlocking angles and duct edge connection system, including gaskets, cleats, and corner clips.
  4. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock ductwork is not acceptable.
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. All applied connectors at transverse joints shall be sealed using a butyl rubber gasket that is supplied by the manufacturer and installed in the field by the Contractor.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
  2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- D. Slip and drive connections are acceptable for low pressure (3 inch and below W.G.) ductwork as allowed by SMACNA.
- E. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.
- F. Ductmate and TDC are acceptable joint methods for (3 inch and above W.G.) pressure ductwork as allowed by SMACNA.

## **2.06 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION**

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- C. Flat-Oval, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches (1830 mm) in diameter with butt-welded longitudinal seams.
- D. Duct Joints:
1. Ducts up to 20 Inches (500 mm) in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  2. Ducts 21 to 72 Inches (535 to 1830 mm) in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  3. Ducts Larger Than 72 Inches (1830 mm) in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
  4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
  5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
  6. Ductmate and TDC are acceptable joint methods.
- E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts. Use United McGill or equal low-loss takeoffs. Only manufactured fittings are acceptable on mains before terminal boxes or heat pumps. Saddle tap fittings are not acceptable on mains before terminal boxes, however, saddle tap fittings will be acceptable for ductwork after the terminal box and heat pumps.

- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance. Only manufactured fittings are acceptable on mains before terminal boxes. Saddle tap fittings are not acceptable on mains before terminal boxes and heat pumps, however, saddle tap fittings will be acceptable for ductwork after the terminal box and heat pumps.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 4- to plus 6-inch wg (minus 500 to plus 500 Pa):
    - a. Ducts 3 to 36 Inches (75 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
    - b. Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
    - c. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
    - d. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
  3. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
  4. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
  5. Round Elbows 8 Inches (200 mm) and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  6. Round Elbows 9 through 14 Inches (225 through 355 mm) in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  7. Round Elbows Larger Than 14 Inches (355 mm) in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
  8. Die-Formed Elbows for Sizes through 8 Inches (200 mm) in Diameter and All Pressures 0.040 inch (1.0 mm) thick with 2-piece welded construction.
  9. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
  10. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
  11. Pleated Elbows for Sizes through 14 Inches (355 mm) in Diameter and Pressures through 10-Inch wg (2500 Pa): 0.022 inch (0.55 mm).
- H. Gasketed full-bodied fittings, couplings, reducers, elbows, and taps available in 3-through 24-inch diameters. Fittings are secured to the duct with self-tapping screws uniformly located around the circumference as per SMACNA standards. Round fittings are available in single-wall. Fittings are fabricated from G-60 galvanized steel constructed in accordance with ASTM A643 and A924 specifications and meet SMACNA's +10-inch wg positive pressure standard.
- I. Provide paint grip ductwork for all exposed ductwork.

## **PART 3 - EXECUTION**

### **3.01 DUCT APPLICATIONS**

- A. All ducts shall be galvanized steel except as follows, or indicated on plan.

### **3.02 DUCT INSTALLATION**

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in maximum available unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- 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. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

- O. Protect duct interiors from the elements and foreign materials until building is enclosed.
- P. Install all control dampers, motorized dampers, airflow measuring stations and other components furnished by temperature control contractor. Coordinate these requirements with successful temperature control contractor.

### **3.03 SEAM AND JOINT SEALING**

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
  - 1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.
- B. Seal ducts before external insulation is applied.

### **3.04 HANGING AND SUPPORTING**

- A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.

### **3.05 CONNECTIONS**

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION 233113

## **SECTION 233300 - AIR DUCT ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Backdraft dampers.
  - 2. Volume dampers.
  - 3. Fire dampers.
  - 4. Ceiling fire dampers.
  - 5. Smoke dampers.
  - 6. Combination fire and smoke dampers.
  - 7. Manual pressure reducing dampers.
  - 8. Turning vanes.
  - 9. Duct-mounting access and pressure relief doors.
  - 10. Flexible connectors.
  - 11. Flexible ducts.
  - 12. Duct accessory hardware
  
- B. Related Sections:
  - 1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
  - 2. Division 28 Section "Fire Alarm and Detection System" for duct-mounted fire and smoke detectors.

#### **1.03 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Backdraft dampers.
  - 2. Volume dampers.
  - 3. Fire dampers.
  - 4. Ceiling fire dampers.
  - 5. Smoke dampers.
  - 6. Combination fire and smoke dampers.
  - 7. Manual pressure reducing dampers.
  - 8. Duct silencers.
  - 9. Turning vanes.
  - 10. Duct-mounting access and pressure relief doors.
  - 11. Flexible connectors.

12. Louvers.

- B. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

#### **1.04 QUALITY ASSURANCE**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Uniform Mechanical Code.

#### **1.05 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### **PART 2 - PRODUCTS**

#### **2.01 SHEET METAL MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: 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.
- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. 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).

#### **2.02 BACKDRAFT DAMPERS**

- A. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch (150-mm) width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.



1. Frame: 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners and mounting flange.
2. Blades: 0.050-inch- (1.2-mm-) thick aluminum sheet.
3. Blade Seals: Neoprene.
4. Blade Axles: Nonferrous.
5. Tie Bars and Brackets: Aluminum.
6. Return Spring: Adjustable tension.
7. Dampers shall be used on fan discharge only.
8. Dampers shall be American Warming and Ventilating BD-16 or equal.

B. Description: Fabric blade backdraft damper, suitable for horizontal or vertical installations.

1. Frame: 0.050-inch (1.2 mm-) thick extruded aluminum.
2. Blades: Double-coated neoprene; fabric or fiberglass.
3. Blade Edge: Metal.
4. Dampers are not to be used on fan discharge.
5. Dampers shall be American Warming and Ventilating BD-15 or equal.

### **2.03 VOLUME DAMPERS**

A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
2. Aluminum Frames: Hat-shaped, 0.125-inch- (3-mm-) thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
3. Steel Blades: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel; airfoil shaped.
4. Extruded-Aluminum Blades: Minimum of 0.081-inch- (2-mm-) thick, 6063T extruded aluminum.
5. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.
6. Blade Axles: Nonferrous.
7. Blade Axles: Galvanized steel.
8. Tie Bars and Brackets: Aluminum.
9. Tie Bars and Brackets: Galvanized steel.

C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
  - 1. Concealed Operators: Ventlok No. 666 extension operating rod with removable key and chrome escutcheon. Utilize this product in all hard ceiling damper locations.

#### **2.04 FIRE DAMPERS**

- A. General: Labeled to UL 555. Provide dynamic rated dampers in system when fans do not stop.
- B. Fire Rating: One and one-half hours.
- C. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- D. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
  - 1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.
  - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies 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 a blade lock and stainless-steel negator closure spring.
- H. Fusible Link: Replaceable, 165 deg F (74 deg C) rated as indicated.

#### **2.05 CEILING FIRE DAMPERS**

- A. General: Labeled to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
  - 1. In pool install all aluminum dampers.
- B. Frame: 0.040-inch- (1.0-mm-) thick, galvanized, sheet steel; round or rectangular; style to suit ceiling construction.
- C. Blades: 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel with nonasbestos refractory insulation.
- D. Volume Adjustment: UL-labeled, fusible volume-control adjustment.
- E. Fusible Link: Replaceable, 165 deg F (74 deg C) rated.
- F. Fire Rating: 1-1/2 hours.

- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

## **2.06 SMOKE AND FIRE/SMOKE DAMPERS**

- A. Fire Rating: UL 555 classified and labeled as a 1-1/2 hour fire damper.
- B. Smoke Rating: UL 555S classified and labeled as a Leakage Class I Damper for use in smoke control systems.
- C. Leakage Class I: 4 cubic feet per minute per square foot (1.2 m<sup>3</sup>/min/m<sup>2</sup>) at 1 inch w.g. (0.25 kPa) and 8 cubic feet per minute per square foot (2.4 m<sup>3</sup>/min/m<sup>2</sup>) at 4 inches w.g. (1 kPa).
- D. Air Flow Rating: UL approved for dual directional airflow.
- E. Frame: 5 inches x minimum 16 gage (127 x minimum 1.6 mm) roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage (2.3 mm) U-channel.
- F. Blades:
  - 1. Style: Airfoil-shaped, single-piece.
  - 2. Action: Parallel
  - 3. Orientation: Horizontal
  - 4. Material: Minimum 14 gage (2.0 mm) equivalent thickness, galvanized steel.
  - 5. Width: Maximum 6 inches (152 mm).
- G. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.
- H. Seals:
  - 1. Blade: Silicone rubber edge type for smoke seal to 450 degrees F (232 degrees C) and galvanized steel for flame seal to 1,900 degrees F (1,038 degrees C). Mechanically attached to blade edge.
  - 2. Jamb: Stainless steel, flexible metal compression type.
- I. Linkage: Concealed in frame.
- J. Axles: Minimum 1/2 inch (13 mm) diameter plated steel, hex-shaped, mechanically attached to blade.
- K. Mounting: Vertical or Horizontal as indicated.
- L. Heat-Actuated Temperature Release Device:
  - 1. Control close and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
  - 2. Allow damper to be automatically and remotely resettable after test, smoke detection, or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
  - 3. Controlled closure and locking of damper to occur in 3 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
  - 4. Electric with electric actuators
  - 5. Release Temperatures: 165 degrees F (74 degrees C)

- M. Actuator:
1. Electric: 120 V, 60 Hz, two-position
  2. Fifteen Second Criteria: Meet UBC 15 second operation requirement.
- N. Duct Transition Connection: As Indicated
- O. Finish: Mill galvanized.
- P. Assembly: Factory assemble damper, actuator, and accessories and furnish as a single unit conforming to UL 555 and UL 555S.
- Q. Performance Data:
1. Elevated Temperature Qualified: Damper and actuator assembly qualified in accordance with UL 555S to elevated temperature of 250 degrees F (121 degrees C)
  2. Capacity: Demonstrate capacity of damper and actuator assembly to operate, by opening and closing, in HVAC system operating conditions.
    - a. Closed Position: Maximum pressure of 8 inches w.g. (2 kPa).
    - b. Open Position: Maximum air velocity of 4,000 feet per minute (1,219 m/min).
  3. Leakage Class: Leakage Class I, if applied in systems with pressure of 4 inches w.g. (1 kPa) or Leakage Class II, if applied in systems with pressure of 8 inches w.g. (2 kPa).
- R. Accessories
1. Fire Stat:
    - a. UL classified.
    - b. Electrically and mechanically lock damper in closed position when duct temperatures exceed 165 degrees F (74 degrees C) and still allow appropriate authority to override Fire Stat and operate damper as may be required for smoke management functions.
    - c. Allow damper to remain operable while temperature is below 250 degrees F (121 degrees C)
    - d. Interface electrically with building fire alarm systems.
  2. Blade Position Indicator Switches: Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.
- S. Duct Smoke Detector: Provide UL classified, factory mounted, photoelectric-type smoke detector suited for duct velocities of 500 to 4,000 fpm.
- T. Factory Sleeve:
1. Minimum 20 gage (1.0 mm) thickness, minimum 17 inches (432 mm) length.
  2. Silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.

## **2.07 MANUAL PRESSURE REDUCING DAMPERS**

- A. Provide all dampers with locking hand quadrant.

- B. Provide pressure reducing dampers at points on medium pressure supply systems where shown.
- C. Heavy duty round and oval pressure reducing dampers.
  - 1. Frame:
    - a. Dampers under 6 inches shall be 2-inch x 12-gage steel tube.
    - b. Dampers 6 inches through 12 inches shall be 2-inch x 1/2-inch x 14-gage steel channel.
    - c. Dampers above 24 inches shall be 2-inch x 1-inch x 3/16-inch steel channel.
  - 2. Blade:
    - a. Dampers 18 inches in width (oval) or diameter (round) shall be 12 gage.
    - b. Dampers above 18 inches in width (oval) or diameter (round) shall be 10 gage.
  - 3. Axle:
    - a. Dampers 22 inches in width (oval) or diameter (round) shall be 1/2-inch steel.
    - b. Dampers above 22 inches in width (oval) or diameter (round) shall be 3/4-inch steel.
  - 4. Dampers shall be Ruskin Model CDR 25 (round) or Ruskin Model CDO 25 (oval) or equal.
- D. Rectangular Pressure Reducing Dampers:
  - 1. Frame shall be 16 gage galvanized steel formed into structural hat channel shape with tabbed corners for reinforcement. The blades shall be single skin, 16 gage galvanized steel with three longitudinal grooves for reinforcement. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Axles shall be square or hexagonal positively locked into the damper blade.
  - 2. Dampers shall be Ruskin MD35 or equal.

## **2.08 TURNING VANES**

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.
- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## **2.09 DUCT-MOUNTING ACCESS DOORS**

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
2. Provide number of hinges and locks as follows:
  - a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
  - b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
  - c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
  - d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch (25-mm) thickness. Include cam latches.
- D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.
  1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- F. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

## **2.010 FLEXIBLE CONNECTORS**

- A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. 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, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Select metal compatible with ducts.
- C. 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).
- D. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
  1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
  2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
  3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

## **2.011 FLEXIBLE DUCTS**

- A. General: Comply with UL 181, Class 1; maximum length 5 feet.
- B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.
  1. Reinforcement: Steel-wire helix encapsulated in inner liner.

2. Outer Jacket: Polyethylene film.
  3. Inner Liner: Polyethylene film.
- C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.
- D. Flexible Duct Clamps: Nylon strap, in sizes 3 through 18 inches (75 to 450 mm) to suit duct size.

## **2.012 LOUVERS**

- A. Horizontal, Drainable, Fixed-Blade Louvers: Extruded-aluminum frames and louver blades, designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and channels in jambs and mullions, complying with the following requirements:
1. Louver Depth: 6 inches (100 mm), unless otherwise indicated.
  2. Frame Thickness: 0.080 inch, unless otherwise indicated.
  3. Blade Thickness: 0.080 inch, unless otherwise indicated.
  4. Blade Angle: 35 degrees, unless otherwise indicated.
  5. Louvers shall be American Warming, Greenheck, Ruskin, Pottorff or equal.
- B. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermo cured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2
  2. Color: Submit manufacturer standard color chart to Architect/Engineer.
- C. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.
- D. Louver Screens: On inside face of exterior louvers, provide 1/2-inch square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

## **2.013 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 length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size. Plastic bands may be used at diffusers.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

- E. Galvanized Steel Wire Cloth: 2 inch by 2 inch mesh, 0.063 inch diameter wire hot dipped in refined zinc to lock wires in place.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION AND INSTALLATION**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" for metal ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- D. Provide manual pressure reducing dampers where indicated on drawings.
- E. Install volume dampers in duct. Install Ventlock 666 extension in inaccessible ceilings.
- F. Install duct silencers rigidly to ducts.
- G. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- I. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
  - 1. On both sides of duct coils.
  - 2. Downstream from volume dampers, turning vanes, and equipment.
  - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
  - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
  - 5. On sides of ducts where adequate clearance is available.
  - 6. Install pressure relief access doors wherever quick closing dampers are located, ie. Fire/smoke dampers.
- J. Install the following sizes for duct-mounting, rectangular access doors:
  - 1. One-Hand or Inspection Access: 12 by 12 inches (200 by 125 mm).
  - 2. Two-Hand Access: 12 by 12 inches (300 by 150 mm).
  - 3. Head and Hand Access: 18 by 18 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. Install the following sizes for duct-mounting, round access doors:
  - 1. One-Hand or Inspection Access: 12 inches (200 mm) in diameter.
  - 2. Two-Hand Access: 12 inches (250 mm) in diameter.
  - 3. Head and Hand Access: 14 inches (300 mm) in diameter.
  - 4. Head and Shoulders Access: 18 inches (460 mm) in diameter.
  - 5. Body Access: 24 inches (600 mm) in diameter.
  
- L. Install the following sizes for duct-mounting, pressure relief access doors:
  - 1. One-Hand or Inspection Access: 12 inches (125 mm) in diameter.
  - 2. Two-Hand Access: 12 inches (250 mm) in diameter.
  - 3. Head and Hand Access: 14 inches (330 mm) in diameter.
  - 4. Head and Shoulders Access: 18 inches (480 mm) in diameter.
  
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment."
  
- N. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
  
- O. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
  
- P. Connect terminal units to supply ducts directly.
  
- Q. Connect diffusers to low pressure ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
  
- R. Connect flexible ducts to metal ducts with draw bands.
  
- S. Install duct test holes where indicated and required for testing and balancing purposes.
  
- T. Install roof hoods per manufacturer's recommendations.

### **3.02 ADJUSTING**

- A. Adjust duct accessories for proper settings.
  
- B. Adjust fire and smoke dampers for proper action.
  
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233300



# SECTION 233423 - HVAC POWER VENTILATORS

## PART 1 - GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Centrifugal roof ventilators.
  - 2. Ceiling-mounting ventilators.

### 1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

### 1.04 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material thickness and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Roof curbs.
  - 7. Fan speed controllers.
- 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.
  - 2. Design Calculations: Calculate requirements for selecting vibration isolators for designing vibration isolation bases.
  - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

- C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Roof framing and support members relative to duct penetrations.
  - 2. Ceiling suspension assembly members.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

#### **1.05 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

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

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

#### **1.07 COORDINATION**

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### **1.08 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Belts: One set(s) for each belt-driven unit.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

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

1. Centrifugal Sidewall Ventilators:

- a. Cook, Loren Company.
- b. Greenheck Fan Corp.
- c. Twin City Fan
- d. PennBarry

2. Ceiling-Mounting Ventilators:

- a. Cook, Loren Company.
- b. Greenheck Fan Corp.
- c. Twin City Fan
- d. PennBarry

### **2.02 CENTRIFUGAL SIDEWALL VENTILATORS**

A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, base, and accessories.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drain.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent. Factory mount inside the fan housing and factory wire. If not factory mounted and wired mechanical contractor to field mount and run all necessary control wiring if not unit mounted.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Provide explosion proof fans and motors as indicated on the plans.
5. Motorized backdraft damper.

### **2.03 CEILING-MOUNTING VENTILATORS**

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications. Two speed, continuous operation where noted on the drawings.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- E. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent. Factory mount inside the fan housing and factory wire. If not factory mounted and wired mechanical contractor to field mount and run all necessary control wiring if not unit mounted.
  - 2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
  - 3. Isolation: Rubber-in-shear vibration isolators.
  - 4. Manufacturer's standard roof cap, wall cap and transition fittings.
  - 5. Ceiling radiation damper.

### **2.04 MOTORS**

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- B. Enclosure Type: Totally enclosed, fan cooled.
- C. ECM motors where scheduled.

### **2.05 SOURCE QUALITY CONTROL**

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

- C. Install units with clearances for service and maintenance.

### **3.02 CONNECTIONS**

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.03 FIELD QUALITY CONTROL**

- A. Equipment Startup Checks:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Verify lubrication for bearings and other moving parts.
  - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 7. Disable automatic temperature-control operators.
- B. Starting Procedures:
  - 1. Energize motor and adjust fan to indicated rpm.
  - 2. Measure and record motor voltage and amperage.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Shut unit down and reconnect automatic temperature-control operators.
- F. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- G. Replace fan and motor pulleys as required to achieve design airflow.
- H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

### **3.04 ADJUSTING**

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

### **3.05 CLEANING**

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

### **3.06 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
- B. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
- C. Review data in maintenance manuals.
- D. Schedule training with Owner, through Architect-Engineer, with at least seven days' advance notice.

END OF SECTION 233423



## **SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENT**

- 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 ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
  - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
  - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### **1.03 SUBMITTALS**

- A. Product Data: For each product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. 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.
- C. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- D. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

A. Products: Subject to compliance with requirements, provide one of the following:

1. Diffusers, registers and grilles
  - a. Anemostat
  - b. Titus.
  - c. Tuttle & Bailey.
  - d. Nailor
  - e. Price
  - f. MetalAire
  - g. Hart and Cooley

### **2.02 GRILLES AND REGISTERS**

A. Adjustable Bar Grille and Register:

1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Adjustable horizontal or Adjustable vertical spaced as scheduled.
4. Rear Blade Arrangement: Adjustable horizontal or Adjustable vertical spaced as scheduled.
5. Frame: As scheduled.
6. Mounting: As scheduled.
7. Damper Type: As scheduled.
8. Accessories: As required.

B. Fixed Face Grille and Register:

1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Arrangement: 1/2-by-1/2-by-1/2-inch (13-by-13-by-13-mm) grid core.
4. Frame: As scheduled.
5. Mounting: As scheduled.
6. Damper Type: As scheduled

### **2.03 CEILING DIFFUSER OUTLETS**

A. Round Ceiling Diffuser:

1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Style: As scheduled.
4. Pattern: As scheduled.
5. Dampers: As scheduled.
6. Accessories: As required. Radiation damper on ceiling assembly penetrations.

B. Rectangular and Square Ceiling Diffusers:

1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white.
3. Face Style: As scheduled.
4. Face Size: As scheduled.
5. Mounting: As scheduled.
6. Pattern: As scheduled.
7. Dampers: As scheduled.
8. Accessories: As required. Radiation damper on ceiling assembly penetrations.

C. Louver Face Diffuser:

1. Material: Aluminum.
2. Finish: Baked enamel, white
3. Face Size: As scheduled.
4. Mounting: As scheduled.
5. Pattern: As scheduled.
6. Dampers: As scheduled.
7. Accessories: As required. Radiation damper on ceiling assembly penetrations.

**2.04 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

**PART 3 - EXECUTION**

**3.01 EXAMINATION**

- A. Examine areas where diffusers, 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 practicable. 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 233713

## **SECTION 235216 - CONDENSING BOILERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim and accessories for generating hot water.

#### **1.3 SUBMITTALS**

- A. Product Data: Include performance data, operating characteristics, furnished specialties and accessories.
- B. Shop Drawings: For boilers, boiler trim and accessories, include:
  - 1. Plans, elevations, sections, details and attachments to other work
  - 2. Wiring Diagrams for power, signal and control wiring
- C. Operation and Maintenance Data: Data to be included in boiler emergency, operation and maintenance manuals.
- D. Warranty: Standard warranty specified in this Section
- E. Other Informational Submittals:
  - 1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

#### **1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices and Accessories: Boilers must be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.
- C. ASME Compliance: Condensing boilers must be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section IV "Heating Boilers".
- D. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

- E. UL Compliance: Boilers must be tested for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

## 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 03.

## 1.6 WARRANTY

- A. Standard Warranty: Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

### 1. Warranty Period for Fire-Tube Condensing Boilers

- a. The pressure vessel/heat exchanger shall carry a 10-year from shipment, prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.
- b. Manufacturer labeled control panels are conditionally warranted against failure for (2) two years from shipment.
- c. All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. It shall be the responsibility of the Contractor to ensure that any substituted equipment is equivalent in fit, form and function to the specified equipment. The cost of any additional work caused by the substitution of equipment shall be borne by the Contractor.
- B. Or approved equal.

### 2.2 GENERAL REQUIREMENTS

- A. Boiler
  - 1. The boiler shall be assembled, fire tested and shipped as a factory-packaged unit, complete with jacket, gas manifold, burner and controls mounted & wired, with boiler connections specified in this Section.
  - 2. The boiler shall be constructed in conformance to ASME Section IV , ASME CSD-1 and ANSI Z21.13. The boiler shall bear the ASME "H" stamp with a maximum allowable working pressure (MAWP) of 160 PSI. Pressure vessel shall be subjected to a hydrostatic pressure test of 240 PSIG at the factory before shipment.
  - 3. The boiler shall be an ultra-high efficiency condensing boiler with a pressure vessel, constructed of 316L stainless steel and of water tube design, which shall not require a refractory combustion chamber.
  - 4. The boiler shall be equipped with an integral pre-mix, metal-mesh type forced draft burner incorporating full modulation with 5:1 turndown.

5. The boiler gas valve will be designed with zero pressure regulation and equipped with a variable speed blower system to precisely control the fuel/air mixture, providing fully modulating firing rates for maximum efficiency.
6. All piping and wiring connections shall be located on the left-side of the boiler. Connections include: supply / return water connections, condensate trap drain, and gas valve inlet connection. Condensate trap shall have a factory supplied compression fitting. A factory supplied drain valve and oversized relief valve shall be provided with the boiler(s).
8. The flue passages and combustion chamber shall be accessible from the front of the boiler for cleaning.
9. The boiler shall be provided with a heavy duty 20 gauge steel jacket with a rust resistant powder coat finish to allow for same-size or smaller model stacking without the need of a separate rack system. Jackets made of plastic or resin material shall not be acceptable. The boiler jacket shall contain an internal electrical cabinet for power and limit circuit wiring, providing a clean finished look when the jacket is installed. Electrical connections shall be accessible from left-side of the boiler on two (2) printed circuited boards (120VAC high and 24VAC/5VDC low voltage) with fused connections for protection and clear labeling for simple and accurate wiring. Individual lift-off jacket front panel may be installed after system piping and wiring to allow ease of access to the pressure vessel.
  - a. The electrical components shall be separated from incoming combustion air gas, which may contain excess humidity, dust and other contaminants brought through ducted combustion air.
10. A polypropylene condensate trap with a float-actuated shut-off switch shall be located within the boiler jacket and beneath the heat exchanger drain pan. The float-actuated shutoff switch must be located upstream from any bends in the condensate trap. Float switches located on the downstream side of the condensate trap shall not be acceptable due to the possibility of blockages occurring in the trap bends.
  - a. The float-actuated switch shall be offset from the condensate drip to prevent mineral build-up from interfering with the switch actuation.

## B. Boiler Control System

### 1. Scope of Supply

Boiler Control System shall provide safety interlocks and water temperature control. The control system shall be fully integrated into the boiler control cabinet and incorporate single and multiple boiler control logic, inputs, outputs and communication interfaces. The control system shall coordinate the operation of up to eight (8) fully modulating hot water boilers and circulation pumps. The control system shall simply control boiler modulation and on/off outputs based on the boiler water supply temperature and an operator-adjusted setpoint. However, using parameter menu selections, the control system shall allow the boiler to respond to remote system water temperature and outside air temperatures with domestic hot water priority (DHWP) and warm weather shut down (WWSD) or energy management system (EMS) firing rate demand, remote setpoint or remote start/stop commands. In order to support large domestic demands it shall be parameter selectable to start two boilers simultaneously in response to a DHWP demand.

### 2. Boiler Control

Using PID (proportional-integral-derivative) based control, the remote system water temperature shall be compared with a setpoint to establish a target boiler firing rate. If the secondary loop flow speed is greater than the primary loop flow speed, firing rate is increased in response to the decrease in secondary loop temperature. When the remote system temperature is near the boiler

high limit temperature, the boiler supply sensor shall limit the maximum boiler supply temperature to prevent boiler high limit events. Alternately, using parameter menu selections, the control system shall allow the boiler to respond directly to boiler supply temperature and setpoint to establish a target boiler firing rate while remote system water temperature is used for display purposes only. Each boiler's fuel flow control valve shall be mechanically linked to the air flow control device to assure an air rich fuel/air ratio. All the automated logic required to ensure that pre-purge, post-purge, light-off, and burner modulation shall be provided.

3. Hot Water Temperature Setpoint

When the controller is in the local control mode, the control system shall establish the setpoint based on outside air temperature and a reset function curve, or be manually adjusted by the operator. When enabled, the setpoint shall be adjusted above a preset minimum setpoint upon sensing a domestic hot water demand contact input. When in remote mode, the control system shall accept a 4-20ma or Modbus or 0-10V remote setpoint or firing rate demand signal from an external EMS.

4. Multiple Boiler Sequence

The controller shall incorporate its peer-to-peer communications on each connected boiler (up to eight [8] units) by using standard RJ45 ethernet cables. The control system shall allow the connected boilers to exchange signals as required to provide coordinated fully modulating lead/lag functions. It shall not be required to wire individual control signals between boilers. Multiple boilers shall be modulated in "Unison" (all at the same firing rate). To increase operational efficiency, the control system shall utilize both water temperature and firing rate based boiler sequencing algorithms to start and stop the boilers and shall minimize the total number of boilers in operation. The control system shall start and stop boilers when the water temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize temperature deviations, the control system shall start and stop the next boiler when the "lead" boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The boiler shall be run at low fire for warm-up for a preset low fire hold time. When enabled, warm weather shut down control logic shall prevent boiler operation. The controller shall also be capable of auto-rotation of the boilers based on user-selected run time hours.

5. User Interface

A touch screen message display shall be provided to display real time BTU/hr, numeric data, startup and shutdown sequence status, alarm, system diagnostic, first-out messages and boiler historical information. In the event of a fault condition, the display shall provide help screens to determine the cause of the problem and corrective actions. Historical information shall include graphical trends, lockout history, boiler & circulator cycle counts and run time hours.

6. Circulator Control

The controller shall be capable of sequencing the boiler, domestic hot water or system circulators. Simple parameter selections shall allow all three pumps to respond properly to various hydronic piping arrangements including either a boiler or primary piped indirect water heater. The controller shall perform circulator exercise to help prevent pump rotor seizing. The boiler circulator can be variable speed and supplied by the boiler manufacturer to work integrally with the boiler's control system to optimize energy savings.

7. External Data Transfer

The control system shall include the ability to transfer parameters from boiler to boiler. Upon completion of commissioning the first boiler, a USB flash drive shall allow settings to be



“downloaded” from one boiler and “uploaded” into the next. Additionally, these files shall be able to be sent via email and “uploaded” to a remote technical support system. Additionally, it shall be possible to restore parameters to the “as shipped state” by selecting a “Factory Default” Button.

8. Archive History

All hard lockouts, soft lockouts (holds), sensor faults, Energy Management System (EMS) signal faults, sequencer faults and limit string faults shall be recorded with a time and date stamp. The time and date log shall stores up to 3000 alarm & events even after power cycle.” The alarm & event log must be downloadable to a USB thumb drive. The control shall include collect and store supply & return temperature, flame intensity and firing rate for at least 4 months. It shall be a simple matter to page through the boiler’s operation using the boiler mounted display or download the historical data to a USB thumb drive for off-site analysis. All data must be stored in standardly compatible CRV files.

9. Quality Assurance

The boiler control system shall be supplied as part of a factory-assembled and tested burner control cabinet.

B. Boiler Trim

1. Combination pressure-temperature gauge, 3-1/2 inch diameter.
2. Supply and return temperature sensors - shall be mounted on the supply and return connections inside the boiler jacket. Each sensor shall be accessible through a removable access door on the left side of the boiler. The boiler control shall measure supply and return temperatures and notify the operator if the direction of flow is reversed.
  - a. The boiler control shall adjust to impending temperature changes in such a way to minimize fuel consumption and maximize efficiency. The control shall measure temperatures and the rate of change in those temperatures and respond early, rather than waiting for temperatures to exceed limit control settings.
3. Outdoor air temperature sensor, if required, to automatically adjust the modulation rate setpoint on the boiler according to the outdoor temperature to optimize boiler operation and efficiency.
4. Flue gas temperature sensor shall be mounted in the flue vent connector to monitor flue gas temperatures and reduce the blower speed when flue gas temperatures exceed 184°F. If the flue temperatures exceed 194°F, a forced boiler recycle results.
5. ASME Section IV safety relief valve sized to exceed the gross output of the boiler which shall be factory set to relieve pressure at 60 PSI water working pressure.
6. Water flow switch to prevent the burner operation during low water flow conditions.
7. Air vent valve shall be included to release trapped air inside the boiler’s heat exchanger.
8. Drain valve, 3/4 inch.
9. High Temperature Limit, automatic and manual reset, to prevent burner operation if water temperature conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
10. High and low gas pressure switches with a range of 4.5 - 13.5 PSIG, wired to put the boiler into a hard lockout, requiring manual reset of the boiler primary safeguard control.
11. Low water cutoff (LWCO) device with manual reset. Boiler shall be fitted with a probe type LWCO located above the lowest safe permissible water level established by the boiler manufacturer.

LWCO shall be UL listed and FM approved and suitable for commercial hydronic heating service at 80 PSI.

E. Vent & Intake Air Connections

1. Boiler vent connection shall accept CPVC, polypropylene or stainless steel without the need of a separate vent adapter.
2. Combustion analyzer test port shall be available on the boiler vent connection.
3. The vent system shall be in accordance with National Fuel Code, NFPA 54/ANSI Z221.3 or CAN/CSA B149.1 Installation Code for Canada, or, applicable provisions of local building codes.
4. The boiler shall be vented using PVC/CPVC vent material in accordance with local code. A Factory supplied 90° elbow (schedule 80 CPVC) and a 30-inch length of schedule 40 CPVC pipe must be included as a transition from the boiler to traditional solid core schedule 40 PVC vent material. Foam core pipe shall not be an approved vent material for either intake/exhaust piping. Vent connections must be located at the rear of the boiler.
5. Air intake shall be connected into the boiler vestibule NOT directly into the boiler blower assembly.
6. Air intake piping shall be PVC that is sealed and pressure tight. Pipe must be at least the same size as the inlet air connection on the boiler.
7. Venting shall have an equivalent length of up to 200 feet maximum and combustion intake air shall have an equivalent length of up to 100 feet maximum.

2.3 PERFORMANCE

- A. Boiler efficiency shall be as stated in the Equipment Schedule of the Contract Documents.
- B. The burner shall emit no more than 20 ppm NO<sub>x</sub> and 50 ppm CO (corrected to 3% O<sub>2</sub>) at all firing rates.
- C. Provide services of a manufacturer's authorized representative to perform combustion test including boiler firing rate, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.

**PART 3 EXECUTION**

3.1 INSTALLATION

- A. In accordance with Contract Documents and boiler manufacturer's printed instructions.
- B. Flush and clean the boiler upon completion of installation in accordance with manufacturer's start-up instructions. The boiler must be isolated when any cleaning or testing of system piping is being performed.
- C. Install skid plumb and level, to plus or minus 1/16 inch over base.
- D. Maintain manufacturer's recommended clearances around and over equipment, and as required by local Code.
- E. Arrange all electrical conduit, piping, exhaust vent, and air intake with clearances for burner removal and service of all equipment.
- F. Connect exhaust vent to boiler vent connection.
- G. If shown in Contract Drawings, connect full sized air inlet vent to flanged connector on boiler.

- H. Connect fuel piping in accordance with NFPA 54. Pipe size to be the same, or greater, than the gas train inlet connection.
- I. Use full size (minimum) pipe/tubing on all gas vent connections.
- J. Connect water piping, full size, to supply and return connections.
- K. Install all piping accessories per the details on the contract drawings.
- L. Install discharge piping from relief valves (open termination for viewing) and all drains to nearest floor drain.
- M. Provide necessary water treatment to satisfy manufacturer's specified water quality limits.
- N.

END OF SECTION



## **SECTION 236313 - AIR COOLED REFRIGERANT CONDENSERS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes air-cooled condensing units.

#### **1.2 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Wiring diagrams.
- C. Operation and maintenance data.

#### **1.3 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

#### **1.4 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period (Compressor Only): Five years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 CONDENSING UNITS, AIR COOLED, 2 TO 10 TONS**

- A. Manufacturers:
  - 1. Carrier Corporation; Carrier Air Conditioning Div.
  - 2. Aeon
  - 3. McQuay International.
  - 4. Trane Co. (The); Worldwide Applied Systems Group.

5. York, a Johnson Controls Company
- B. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls.
- C. Compressor: Hermetic or semi-hermetic compressor designed for service with crankcase sight glass, crankcase heater, and back seating service access valves on suction and discharge ports.
  1. Refrigerant Charge: R-410A.
- D. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.
- E. Condenser Fans: Propeller-type vertical discharge; either directly or belt driven. Include the following:
  1. Permanently lubricated ball-bearing motors.
  2. Separate motor for each fan.
  3. Dynamically and statically balanced fan assemblies.
- F. Operating and safety controls include the following:
  1. Manual-reset, high-pressure cutout switches.
  2. Automatic-reset, low-pressure cutout switches.
  3. Low oil pressure cutout switch.
  4. Compressor-winding thermostat cutout switch.
  5. Three-leg, compressor-overload protection.
  6. Control transformer.
  7. Magnetic contactors for compressor and condenser fan motors.
  8. Timer to prevent excessive compressor cycling.
- G. Accessories:
  1. Electronic programmable thermostat to control condensing unit and evaporator fan.
  2. Gage Panel: Package with refrigerant circuit suction and discharge gages.
  3. Part-winding-start timing relay, circuit breakers, and contactors.
- H. Unit Casings: Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:
  1. Steel, galvanized or zinc coated, for exposed casing surfaces; treated and finished with manufacturer's standard paint coating.
  2. Perimeter base rail with forklift slots and lifting holes to facilitate rigging.
  3. Gasketed control panel door.
  4. Nonfused disconnect switch, factory mounted and wired, for single external electrical power connection.
  5. Condenser coil hail guard to protect coil from physical damage.
- I. Verification of Performance: Rate condensing units according to ARI 340/360.

## **2.2 SOURCE QUALITY CONTROL**

- A. Verification of Performance: Rate condensing units according to ARI 210/240, ARI 340/360, or ARI 365.
  - 1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- B. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- B. Install condensing units on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.
- C. Vibration Isolation: Mount condensing units on restrained spring isolators with a minimum deflection of 1 inch. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
- F. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."

### **3.2 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform electrical test and visual and mechanical inspection.
  - 2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 5. Verify proper airflow over coils.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- C. Remove and replace malfunctioning condensing units and retest as specified above.

END OF SECTION 236313



## **SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

#### **1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### **1.5 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: One year(s) from date of Substantial Completion.
    - b. For Parts: One year(s) from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
  - 2. Daikin
  - 3. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
  - 4. SANYO North America Corporation; SANYO Fisher Company.
  - 5. LG

#### **2.2 INDOOR UNITS (5 TONS OR LESS)**

- A. Wall-Mounted, Evaporator-Fan Components:
  - 1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  - 2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
  - 3. Fan: Direct drive, centrifugal.
  - 4. Fan Motors:

- a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
  - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
  - c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  - d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  - e. Mount unit-mounted disconnect switches on interior of unit.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
- a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

### **2.3 OUTDOOR UNITS (5 TONS OR LESS)**

- A. Air-Cooled, Compressor-Condenser Components:
- 1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
  - 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    - a. Compressor Type: Scroll.
    - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    - c. Refrigerant Charge: R-407C or R-410A.
    - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
  - 3. Fan: Aluminum-propeller type, directly connected to motor.
  - 4. Motor: Permanently lubricated, with integral thermal-overload protection.
  - 5. Low Ambient Kit: Permits operation down to 20 deg F.

### **2.4 ACCESSORIES**

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
- 1. Compressor time delay.
  - 2. 24-hour time control of system stop and start.
  - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  - 4. Fan-speed selection including auto setting.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- E. Drain Hose: For condensate.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
  - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### **3.4 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

### **3.5 FUNCTIONAL PERFORMANCE TESTING**

- A. System functional performance testing is part of the Commissioning Process as detailed in 00 18 11 General Commissioning Requirements. Functional performance testing shall be performed by the contractor and witnessed and documented by the Commissioning Professional.

#### **END OF SECTION**



# SECTION 238219 - FAN COIL UNITS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. This Section includes fan-coil units and accessories.

### 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating 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. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.
- D. Warranty: Special warranty specified in this Section.

### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## **1.5 COORDINATION**

- A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of wall sleeves for outdoor-air intake.

## **1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Compressor failure.
    - b. Condenser coil leak.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## **1.7 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan-Coil-Unit Filters: Furnish one spare filter for each filter installed.
  - 2. Fan Belts: Furnish one spare fan belts for each unit installed.

## **PART 2 - PRODUCTS**

### **2.1 DUCTED FAN-COIL UNITS**

- A. Basis-of-Design Product or a comparable product by one of the following:
  - 1. Airtherm
  - 2. Carrier Corporation.
  - 3. First Co.
  - 4. Daikin
  - 5. Trane.
  - 6. JCI/YORK International Corporation.
- B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- C. Coil Section Insulation: 1/2-inch (13-mm) thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
  - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- D. Drain Pans: Plastic. Fabricate pans and drain connections to comply with ASHRAE 62.1-2004.
  - E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.
  - F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
    1. Supply-Air Plenum: Sheet metal plenum finished and insulated to match the chassis.
    2. Return-Air Plenum: Sheet metal plenum finished to match the chassis.
    3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
    4. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.
  - G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
    1. Pleated Cotton-Polyester Media: 7 MERV.
  - H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.
  - I. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size with furnace. Include condensate drain pan with accessible drain outlet.
    1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.
  - J. Refrigerant Line Kits: Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.
    1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I, 1/2 inch thick.
  - K. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.
  - L. Control devices and operational sequence are specified in Division 23 Section "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install fan-coil units level and plumb.
- B. Install fan-coil units to comply with NFPA 90A.
- C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
- E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
  - 1. Install piping adjacent to machine to allow service and maintenance.
  - 2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
  - 3. Connect condensate drain to indirect waste.
    - a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.



- B. Remove and replace malfunctioning units and retest as specified above.

### **3.5 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. 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 Project during other than normal occupancy hours for this purpose.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238219



# SECTION 238233 - CONVECTORS

## 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. This Section includes the following:
  - 1. Hydronic finned-tube radiators.

### 1.3 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each type of product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Plans, elevations, sections, and details.
  - 2. Details of custom-fabricated enclosures indicating dimensions.
  - 3. Location and size of each field connection.
  - 4. Location and arrangement of piping valves and specialties.
  - 5. Location and arrangement of integral controls.
  - 6. Enclosure joints, corner pieces, access doors, and other accessories.
  - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members, including wall construction, to which convection units will be attached.
  - 2. Method of attaching convection units to building structure.
  - 3. Penetrations of fire-rated wall and floor assemblies.
- D. Color Samples for Initial Selection: For units with factory-applied color finishes.
- E. Operation and Maintenance Data: For convection heating units to include in emergency, operation, and maintenance manuals.

## **1.4 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## **PART 2 - PRODUCTS**

### **2.1 HOT-WATER FINNED-TUBE RADIATORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Finned-Tube Radiators:
    - a. Engineered Air.
    - b. Slant/Fin.
    - c. Sterling Heating Equipment.
    - d. Vulcan
    - e. Rittling
- B. Heating Elements: Seamless copper tubing suitable for soldered fittings, mechanically expanded into evenly spaced aluminum fins.
- C. Element Hangers: Ball-bearing cradle type with unrestricted longitudinal movement on enclosure brackets.
- D. Enclosures: Enameled steel with easily jointed components for wall-to-wall installation, rigidly supported on wall- or floor-mounting brackets.
  - 1. Enclosures 18 Inches (450 mm) and Less in Height: 0.0478-inch- (1.2-mm-) thick steel.
  - 2. Support Brackets: Locate at maximum 36-inch (1000-mm) spacing.
  - 3. Finish: Factory-applied baked enamel in manufacturer's standard color.
  - 4. Access Doors: Factory made, permanently hinged with Allen-head camlock fastener, minimum size 6 by 7 inches (150 by 175 mm), integral with enclosure for otherwise inaccessible valves.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas to receive convection heating units for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for hydronic-piping connections to verify actual locations before convection heating unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 FINNED-TUBE RADIATOR INSTALLATION**

- A. Install units level and plumb.
- B. Install finned-tube radiators according to Guide 2000 - Residential Hydronic Heating.
- C. Install enclosure continuously around corners, using outside and inside corner fittings.
- D. Join sections with splice plates and filler pieces to provide continuous enclosure.
- E. Install access doors for access to valves.
- F. Install enclosure continuously from wall to wall.
- G. Terminate enclosures with manufacturer's end caps, except where enclosures are indicated to extend to adjoining walls.
- H. Install valves within reach of access door provided in enclosure.
- I. Install air-seal gasket between wall and recessing flanges or front cover of fully recessed unit.
- J. Install piping within pedestals for freestanding units.

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect hot-water units and components to piping according to Division 23 Section "Hydronic Piping."
  - 1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.
- C. Install control valves as required by Division 23 Section "HVAC Instrumentation and Controls."
- D. Install piping adjacent to convection heating units to allow service and maintenance.
- E. Ground electric convection heating units according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper convection heating unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- B. Remove and replace convection heating units that do not pass tests and inspections and retest as specified above.

END OF SECTION 238233

# SECTION 238239 - UNIT HEATERS

## 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. Cabinet unit heaters with centrifugal fans and hot-water coils.
  - 2. Propeller unit heaters with hot-water coils.

### 1.03 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

### 1.04 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Plans, elevations, sections, and details.
  - 2. Location and size of each field connection.
  - 3. Details of anchorages and attachments to structure and to supported equipment.
  - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Location and arrangement of piping valves and specialties.
  - 6. Location and arrangement of integral controls.
  - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
  2. Structural members to which unit heaters will be attached.
  3. Method of attaching hangers to building structure.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
  6. Perimeter moldings for exposed or partially exposed cabinets.
- D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.
- E. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

**1.05 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

**1.06 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

**PART 2 - PRODUCTS**

**2.01 CABINET UNIT HEATERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. McQuay International.
  2. Trane Company (The); North American Commercial Group.
  3. Sterling.
  4. Reznor.
  5. Modine Manufacturing Co.
  6. Rittling
  7. Vulcan



8. Williams
  9. Airtherm
- B. Description: A factory-assembled and -tested unit complying with ARI 440.
1. Comply with UL 2021.
- C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing or erosion-resistant coating to prevent erosion of glass fibers.
1. Thickness: 1 inch (25 mm)
  2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F (0.037 W/m x K at 24 deg C) mean temperature.
  3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
  4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
- D. Cabinet: Steel with baked-enamel finish with manufacturer's custom paint, in color selected by Architect.
1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- (1.35-mm-) thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
  2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- (1.35-mm-) thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
  3. Recessing Flanges: Steel, finished to match cabinet.
  4. Control Access Door: Key operated.
  5. Base: Minimum 0.0528-inch- (1.35-mm-) thick steel, finished to match cabinet, 4 inches (100 mm) high with leveling bolts.
  6. Extended Piping Compartment: 8-inch- (200-mm-) wide piping end pocket.
  7. False Back: Minimum 0.0428-inch- (1.1-mm-) thick steel, finished to match cabinet.
- E. Filters: 1-inch- (25-mm-) thick, glass-fiber media in fiberboard frame.
- F. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.
- G. Fan and Motor Board: Removable.
1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
  2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- H. Control Devices: Unit-mounted fan-speed switch and thermostat, unless shown to be remote mounted on the drawings. If remote mounted provide thermostat to the mechanical contractor to install.
- I. Electrical Connection: Factory wire motors and controls for a single field connection.
- J. Cabinet: For one or more of the following configurations as indicated on drawings:
1. Surface, wall mounting.

- a. Air Inlet: Front grille or open bottom as indicated.
    - b. Air Outlet: Front or Top grille as indicated.
  - 2. Surface, ceiling mounting.
    - a. Air Inlet: Front or bottom grille as indicated.
    - b. Air Outlet: Front or top grille as indicated.
  - 3. Semirecessed, wall-mounting front grilles for air inlet and outlet.
  - 4. Semirecessed, ceiling-mounting front grilles for air inlet and outlet.
  - 5. Recessed, wall-mounting front grilles for air inlet and outlet.
  - 6. Recessed, ceiling-mounting front grilles for air inlet and outlet.
- K. Airflow: Up or down flow as indicated.

## **2.02 PROPELLER UNIT HEATERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. McQuay International.
  - 2. Trane Company (The); North American Commercial Group.
  - 3. Sterling.
  - 4. Reznor.
  - 5. Modine Manufacturing Co.
  - 6. Rittling
  - 7. Vulcan
  - 8. Williams
  - 9. Airtherm
- B. Description: An assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.
- D. Comply with UL 823.
- E. Cabinet: Removable panels for maintenance access to controls.
- F. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- G. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- H. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.
- I. Hot-Water Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 325 deg F (163 deg C), with manual air vent. Test for leaks to 350 psig (2413 kPa) underwater.
- J. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

- K. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Type: Permanently lubricated, multispeed.

### **2.03 CONTROLS**

- A. Control Devices: See other Division 23 sections for control devices and sequence of operations for hot water unit heaters.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers.
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- G. Install new filters in each unit within two weeks of Substantial Completion.

### **3.03 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
- D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
- E. Comply with safety requirements in UL 1995.
- F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."
- G. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- H. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **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 motor rotation and unit operation.
  2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### **3.05 ADJUSTING**

- A. Adjust initial temperature set points.
- B. 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 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 cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 238239

# SECTION 26 0000 - ELECTRICAL GENERAL REQUIREMENTS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

- A. Electrical General Requirements specifically applicable to Division 26 Sections, in addition to Division 01 - General Requirements.
- B. Definitions common to Division 26 specification sections.

### 1.02 RELATED DOCUMENTS

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26.
- B. 01 91 13 - Commissioning Specifications
- C. This section is related to all other sections of Division 26.

### 1.03 DEFINITIONS

- A. Words "Architect" where written in Division 26 specifications and drawings refer to commissioned Design Professional, whose name appears on contract documents.
- B. Word "Engineer" where written in Division 26 specifications and drawings refers to Consulting Electrical Engineer, Obermiller Nelson Engineering, Inc., 1400 Van Buren St NE, #130, Minneapolis, MN 55413; phone 612-249-5600.
- C. Word "Contractor" where written in Division 26 specifications and drawings refers to Electrical Contractor and any and all of his subcontractors.
- D. Word "Material" where written in Division 26 specifications and drawings shall mean any and all apparatus, equipment, devices, fixtures, components, products, assemblies, items, parts, things, and any other pieces specified or shown or required.
- E. Word "Medium Voltage" where written in Division 26 specifications and drawings shall mean 1,000 to 72,500 volts (IEEE).
- F. Word "Labor" where written in Division 26 specifications and drawings shall mean any and all physical effort, manpower, time, expertise, tools, equipment and services to carefully assemble, install and affix all material in a proper, complete and acceptable manner.
- G. Word "Low Voltage" where written in Division 26 specifications and drawings shall mean 0 to 1,000 Volts (IEEE).
- H. Word "Provide" where written in Division 26 specifications and drawings shall mean "Electrical Contractor shall furnish all labor and material and completely and properly install such material and leave same in acceptable condition and intended acceptable working order".
- I. Performance Verification Testing refers to test performed in the field to ensure proper operation and / or installation of service or products.
  - 1. Unless noted otherwise Performance Verification Testing is not required to be provided by a 3<sup>rd</sup> party testing firm.
  - 2. Unless noted otherwise Performance Verification Testing is not required to be witnessed by the Electrical Engineer, Owner, Architect, and / or (if applicable) Commissioning Agent

- J. Acceptance Testing refers to formal testing process required prior to acceptance by the Owner.
  - 1. Unless noted otherwise Acceptance Testing is required to be provided by a 3<sup>rd</sup> party testing firm.
  - 2. Unless noted otherwise Acceptance Testing is required to be witnessed by the Electrical Engineer, Owner, Architect, and / or (if applicable) Commissioning Agent.
- K. As-built drawings are prepared by the contractor. They show, in red ink, on-site changes to the original construction documents.
- L. Record drawings are prepared by the Architect or Engineer and reflect on-site changes the contractor noted in the as-built drawings.
- M. Quality Assurance includes all the planned and systematic activities implemented that can be demonstrated to provide confidence that a product or service will fulfill requirements for quality. Typically, quality assurance procedures are performed before and while the work is being performed. As such in the Division 26 specifications Quality Assurance procedures are specified in Part 1.
- N. Quality Control includes all the planned activities required to verify quality after the work has been performed. This can include testing and inspections along with other procedures. As such in the Division 26 specifications Quality Assurance procedures are specified in Part 3.

#### **1.04 SCOPE OF WORK**

- A. Specifications, corresponding Drawings and Addenda form a complete set of documents for electrical work for this project, and no part shall be considered complete without the other.
- B. Specifications, Drawings, and Addenda describe both the design characteristics and functional performance criteria that the completed electrical and telecommunications and electronic safety and security systems shall include.
- C. Contractor shall obtain required licenses, permits, plan reviews, inspections and pay fees, costs and other charges for this project. Sales, use and any other taxes shall be paid by Contractor.
- D. Electrical Work shall comply with ordinances, laws, regulations and codes applicable to the work involved. If, in any instance, the plans and specifications conflict with such laws, the stricter requirement shall take preference.
- E. If Contractor is aware of conflicts between drawings or specifications and such codes or regulations, they shall be brought to the Engineer's attention prior to commencing work. If Contractor performs work in violation of such codes or regulations, Contractor shall correct the violation at their expense.
- F. Site Investigation
  - 1. Prior to submitting bids, visit the work site to become familiar with existing conditions which may affect the cost of the project. This includes measurements for lengths, quantities, clearances and all other field verifiable conditions.
  - 2. No extra charges will be allowed because of failure of Contractor to become familiar with the existing conditions.
  - 3. Where work under this project requires extension, relocation, or modifications to existing equipment, systems or installations the existing equipment, system or installations shall be restored to their original condition, with exception to the work under this project, before completion.
  - 4. Existing equipment, systems and installations which are not detailed on the drawings must still be restored to their original condition.

### **1.05 ALTERNATES**

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at the Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement (contract).
- B. Coordinate related work and modify surrounding work as required.
- C. Schedule of Alternates: See Division 00 and Division 01.

### **1.06 DRAWINGS**

- A. Drawings indicate the extent and general layout of the electrical systems.
- B. The electrical drawings are diagrammatic (that is, designed to demonstrate or explain the scope of work), they are intended to be as accurate as planning can determine.
- C. The scales are shown for estimating purposes only. Field verification of dimensions, locations, and construction details is required. Review appropriate drawings (for example: shop drawings), make field measurements and adjust work to suit the conditions encountered. Although electrical drawings are diagrammatic, they shall be followed as closely as actual construction permits.
- D. Contractor shall coordinate with civil, architectural, structural, and mechanical construction drawings for locations of partitions, walls, beams, shafts, equipment, etc.
- E. Do not scale locations of items from the electrical drawings.
- F. Standard electrical symbols along with special symbols are used on drawings.

### **1.07 REGULATORY REQUIREMENTS**

- A. Work provided shall comply with the following partial list of governing codes and regulations:
  - 1. International Building Code (IBC).
  - 2. International Fire Code. (IFC).
  - 3. State Fire Codes.
  - 4. State and Local Electric Codes.
  - 5. State Building Code.
  - 6. Serving Utility Regulations.
  - 7. National Fire Protection Association (NFPA) National Fire Codes.
    - a. NFPA 70 – National Electrical Code.
    - b. NFPA 72 – National Fire Alarm and Signaling Code.
  - 8. Americans with Disabilities Act (ADA) requirements.
  - 9. State Health Department Requirements

### **1.08 QUALITY ASSURANCE**

- A. Notify the Architect or Engineer of any discrepancies in or omissions from the drawings and documents. Interpretations and clarifications during bidding will be made only by written Addenda. If discrepancies are not reported, the contractor shall bid the greater quantity or better quality, and appropriate adjustment will be made after contract award.
- B. Any work not clear to Contractor shall be referred to Architect or Engineer for clarification before bid is submitted. If no question is raised prior to opening of bid, Contractor shall be required to provide work, in question, as directed by Architect or Engineer, whose decision shall be final, without additional charges.

- C. By virtue of submitting a bid, Contractor agrees that he is skilled and experienced in use of and in interpretation of drawings and specifications. Contractor further agrees that he has carefully reviewed all drawings, all specifications and all addenda, which constitute bid documents for this contract, and finds them free of ambiguities and good and sufficient for bidding and construction purposes.
- D. Should major changes from drawings and specification be necessary, Contractor shall provide notification and secure written approval and agreement concerning such changes before work is started.

#### **1.09 WARRANTY**

- A. The Electrical Contractor shall guarantee that the materials and equipment included in their work free of defects caused by flawed workmanship, material or equipment failures.
- B. The warranty guarantee shall extend one year minimum from the date of final acceptance of the work or for as long as normal equipment manufacturer warranties are in effect from the date of final acceptance of the work.
- C. During the warranty period, the Electrical Contractor shall respond by making appropriate corrections or repairs required to correct defect within one week of notification. Notification shall be made by telephone, fax, email, or letter.

#### **1.10 ALLOWANCES**

- A. The material and labor allowances listed indicate quantities of material to be installed. They do not indicate associated installation labor, tools, overhead or profit which shall be the Contractor's responsibility to include in base bid along with the cost of the noted materials, no adjustments to the Contract will be allowed for such expenses.

#### **1.11 SUBSTITUTIONS**

- A. Where substitute materials or prior approved materials are provided, Contractor shall assume responsibility and pay for necessary changes resulting from such substitution. This responsibility shall also include any extra costs required by other trades.
- B. Required where specifically noted or where materials are specifically identified by a manufacturer's name, model or catalog number. In these cases only such material may be included in base bid. Prior approval of substitute materials shall be required.
- C. Prior approved substitutions:
  - 1. Requests for prior approval shall be made in accordance with Division 01, as specified below, and indicated in specific specification section.
  - 2. If Contractor desires to furnish materials other than that named, Contractor or supplier shall apply in writing, to Architect, for prior approval of such material at least ten (10) days prior to bid opening date.
  - 3. Requests for prior approved substitution shall indicate specific proposed materials in lieu of those specified together with complete technical data for all such proposed material.
  - 4. Prior approved substitutions will be clearly identified in addenda which will be sent to the bidders well in advance of bid opening. Only material listed on drawings, specifications and addenda shall be provided.
- D. Substitutions after execution of contract: Substitution of materials other than those specifically named in contract documents will be approved, by Architect or Engineer, for following reason only:
  - 1. That material proposed for substitution is equal to or superior, in Engineer and Architect's opinion, to that specified in construction, efficiency, appearance, and utility.



2. That material named in the documents cannot be delivered to project in time to complete work due to conditions beyond control of Contractor.
- E. Equal To and Or Equal: Where materials are specifically identified as “equal to” an identified manufacturer’s name, model, or catalogue numbers or where noted as “or equal” manufacturer’s complying with the requirements of these specifications not listed may be incorporated in the Work. Such materials must be equal to or superior, in Engineer’s opinion, to that specified in construction, efficiency, appearance, and utility.

#### **1.12 GENERAL REQUIREMENTS FOR SUBMITTALS**

- A. Submit according to the requirements of Division 01.
- B. General requirements for Submittals for Review
  1. Submittal format, general information, and requirements for all submittals:
    - a. At the front of the submittal on a dedicated page(s): name, address, and phone number of equipment vendor, engineer, and contractor.
    - b. At the front of the submittal on dedicated page(s): Any deviation from contract requirements shall be called to attention. No deviation will be permitted without written approval of Architect or Engineer.
    - c. At the front of the submittal on dedicated page(s): Any requests for clarification, selections that must be made, etc. shall be called to attention.
    - d. At the front of the submittal on a dedicated page(s): Include a complete list of equipment included with manufacturer and model number or catalog number.
    - e. Submittals shall be grouped to include complete information for related systems, products, and accessories in a single submittal with tabs, dividers, or other means of separating each different component within the submittal from the next.
    - f. Mark dimensions and values in units to match those specified.
    - g. Drawings and brochures shall be clearly marked as to item to be supplied and shall have designation corresponding to designation on Drawings (for example: enclosed switch data shall indicate for which equipment they are provided).
  2. Contractor Review of Submittals
    - a. The Contractor shall thoroughly review each item for compliance with these Specifications making any necessary corrections prior to issuing submittal. Each submittal set shall be stamped, signed and dated indicating Contractor review. If the Contractor fails to properly review submittals, the Contractor shall reimburse the Engineer for all additional reviews on a time and material basis.
    - b. Should the contractor fail to comply with any of the requirements of the specified submittal requirements; then the right is reserved by the Architect or Engineer to select any or all items in the material schedule, with that selection to be final and binding upon the contractor. The materials selected or reviewed, as the case may be, by the Architect and / or Engineer, shall be used in the work at no additional cost to the Owner.
  3. Architect / Engineer Review of Submittals
    - a. The submittal will be reviewed with reasonable promptness, and returned to the Contractor (with copies retained by the Engineer and the Architect). No equipment should be released for shipment until submittals have been approved.
    - b. Submittal review is to verify general conformance with the design concept of the Project and substantial compliance with the information provided in the Contract Documents. This review does not in any way relieve the Contractor or their suppliers of their responsibility to provide all materials and equipment as specified, in quantities, quality and dimensions required.
    - c. Approval Stamp: Submittals will be reviewed with the following actions noted:

- i) "No Exception Taken" indicates that the Submittal appears to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation.
      - ii) "Reviewed as Noted" indicates that the Submittal, after noted corrections are made, appears to conform to the design concept of the Work and that the Contractor, at his discretion, may proceed with fabrication and/or procurement and installation, if the corrections are accepted by the Contractor without an increase in Contract Sum or Time.
      - iii) "Revise and Resubmit" indicates that the noted revisions are such that a corrected copy of the Submittal is required for review to confirm that the noted revisions have been understood and made. The Contractor, at his discretion, may proceed with fabrication and/or procurement and installation after submitting a corrected copy and verifying with the reviewer that the corrected copy is acceptable, if the corrections are accepted by the Contractor without an increase in the Contract Sum or Time.
      - iv) "Rejected" indicates that the Submittal does not appear to conform to the specifications, a resubmission is required and fabrication or procurement is not authorized.
  - 4. If the Architect or Engineer rejects (Revise and Resubmit or Rejected) the same section two times the engineer shall be compensated for additional reviews (beyond the first two) at a rate of \$500 per review. Compensation will be incorporated by Change Order and will be deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the resubmittal process
- C. General Requirements for Submittals For Information
- 1. Information submittals shall include the information noted in the specifications and information requested by the Architect, Engineer, and / or Owner.
  - 2. Coordination Drawings: Where this and other specification sections require Coordination Drawings to be submitted meet the requirements defined in Division 01 and as indicated below.
    - a. Prepare documents using software program required by Division 01. If no requirements are listed utilize a software compatible with AutoDesk's AutoCAD.
    - b. Submit hardcopies and / or electronic copies as required by Division 01. Drawings and files shall be uniquely labeled.
    - c. Scale shall not be less than 1/8" equal 1 foot.
- D. General Requirements for Submittals for Closeout:
- 1. As specified in Division 01 and Section 26 0100.
- E. General Requirements for Product Data. The following are minimum requirements.
- 1. Catalog sheets showing ratings, settings, performance curves and rated capacities.
  - 2. Dimensions, knockout sizes and locations, materials, fabrication details, finish.
  - 3. Outline and support point dimensions, voltage, ampacity, integrated short circuit ampere rating, arrangement and sizes, roughing-in data, and accessories.
  - 4. Operational Characteristics.
- F. General Requirements for Shop Drawings. The following are minimum requirements.
- 1. Electrical ratings of equipment; how the components of the equipment are assembled and function together; and how they will be installed on the project.
  - 2. Dimensioned plans, elevations, sections, and details. Show quantities of installed devices, features, and ratings.
  - 3. Detail enclosure types.
  - 4. Detail configuration, current, and voltage ratings.
  - 5. Detail features, characteristics, ratings, and factory settings devices and auxiliary components.
  - 6. Include wiring diagrams for power, signal, and control wiring.

G. General Requirements for Manufacturer's Instructions. The following are minimum requirements.

1. Application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
2. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
3. Instructions for placing each piece of equipment and system into operation.

## **PART 2 PRODUCTS**

A. Not Used.

## **PART 3 EXECUTION**

A. Not Used.

**END OF SECTION**



# **SECTION 26 0100 - ELECTRICAL SYSTEMS CLOSE OUT DOCUMENTATION**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Operations and Maintenance Manuals.
- B. Warranty Documentation.
- C. Maintenance Materials.
- D. As-Built Drawings.

### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26.
- B. This section is related to all other sections of Division 26.

### **1.03 SUBMITTALS FOR REVIEW**

- A. Submit under provisions of Division 01 and Section – Electrical General Requirements.
- B. Provide operations and maintenance manuals and As-Built drawings.

### **1.04 SUBMITTALS FOR CLOSEOUT**

- A. Provide all documents as described below and in each specification section per the requirements of Division 01 upon reaching substantial completion of the project unless noted otherwise.

## **PART 2 PRODUCTS**

### **2.01 OPERATIONS AND MAINTENANCE MANUALS**

- A. Bind operations and maintenance manual for electrical system in a hard-back binder.
- B. Common Results for Operation and Maintenance Manuals.
  - 1. Provide a master index at the beginning of manual indicating items included.
  - 2. The first section of each manual shall list the name, address, and phone number of Architect, Electrical Engineer, Contractor, and all associated Subcontractors.
  - 3. Each section shall include an approved and edited copy of submittals for review with review comments.
  - 4. Warranty information shall be provided with each piece and / or type of equipment include Manufacturer’s Warranty Statement.
  - 5. Testing Reports shall comply with the requirements of section – Testing of Electrical Systems.
- C. Front cover of each binder shall have the following info:

\*\*\*NAME OF SYSTEM\*\*\*  
OPERATION AND MAINTENANCE MANUAL  
FOR  
PROJECT NAME, PROJECT LOCATION

- D. The Division 26 systems and equipment manual shall include the following sections with dividers between each section and tabs to separate each device with each divided section. See the applicable sections of the Division 26 specifications for additional information.
1. Switchboards.
  2. Distribution Panelboards.
  3. Branch Circuit Panelboards.
  4. Enclosed Switches and Circuit Breakers.
  5. Wiring devices.
  6. Test Reports and Certificates.
  7. Operation and Maintenance Guidelines.
  8. Contractor's Warranty Statement per the requirements of specification "Electrical General Requirements."
- E. The Division 26 Lighting and lighting control manual shall include the following sections with dividers between each section and tabs to separate each device with each divided section. See the applicable sections of the Division 26 specifications for additional information.
1. Luminaires.
  2. Lighting control devices.
  3. Lighting control systems. Include electronic copies of final system programming as well as hard copies.
  4. Receipts for Spare Materials, Owner Training / Demonstrations.
  5. Test Reports and Certificates.
  6. Operation and Maintenance Guidelines.
  7. Contractor's Warranty Statement per the requirements of specification "Electrical General Requirements."

## **2.02 RECORD DRAWINGS**

- A. The contractor shall maintain one set of drawings at the job site to be used as a master copy. Changes and deviations shall be clearly marked and noted by colored pencil. These drawings shall be turned over to the Architect upon project completion.
- B. As-Built Drawings shall include the following information in addition to specific information indicated in individual specification sections:
1. Actual locations / configurations of components and circuits.
  2. Indication of route of all feeders and branch circuits 100-amps and larger.
  3. Indicate route and location of all underground circuits, raceways, pull boxes, etc.
  4. Indicate actual locations and mounting heights of outlet boxes, pull boxes, junction boxes, surface metal raceway, and wireway.
  5. Final locations of all lighting control devices and diagrams showing circuiting / control wiring arrangements.
  6. Provide table indicating final setting of all automatic lighting control sensors.
  7. Provide document indicating final programming of relay panel.
  8. Panel and Switchboard Directories: Provide revised typed directories with As-Built documents.
- C. Indicate other information specifically noted in other Division 26 specification sections.

## **2.03 MAINTENANCE MATERIALS**

- A. Turn over to owner and obtain signed receipt for all maintenance materials, spare parts, touched up parts and loose items.

**PART 3 EXECUTION**

A. Not Used.

**END OF SECTION**





## **SECTION 26 0500 - COMMON WORK RESULTS FOR ELECTRICAL**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. This Section includes limited scope general construction materials and methods for application with electrical, communications, and electronic safety and security systems installations.
- B. Materials specified herein include:
  - 1. Concrete.
  - 2. Miscellaneous for support of electrical materials and equipment.
  - 3. Hangers and Supports.
  - 4. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in walls, floors, ceilings, roofs, foundations for moisture, water, smoke, fire and acoustic control.
- C. General electric construction methods and requirements specified herein include:
  - 1. Material and workmanship.
  - 2. Product manufacturer requirements.
  - 3. Coordination.
  - 4. Safety.
  - 5. Material handling, storage protection, cleaning and painting.
  - 6. Cutting, patching and finishing.
  - 7. Penetrations.
  - 8. Wiring Methods.
  - 9. Balancing Loads.
  - 10. System Interruptions.
  - 11. Outlet mounting heights.
  - 12. Electrical demolition and remodeling.
  - 13. Equipment Wiring (connections).
  - 14. Coordination with Utility Company for permanent electric service, including payment of all Utility Company charges for service.
- D. Owner Instruction and Demonstration.

#### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26.
- B. This section is related to all other sections of Division 26.
- C. Division 03 Section Cast-in-Place Concrete (Miscellaneous Cast-in-Place Concrete).
- D. Division 03 Section Grouting.
- E. Division 03 Section Concrete Boring (Concrete Core Drilling).
- F. Section 26 0100 Electrical Systems Close Out Documentation.

#### **1.03 ELECTRIC SERVICE DESCRIPTION**

- A. Serving Utility Company: Xcel Energy
- B. System Characteristics: As indicated on drawings.

#### 1.04 REGULATORY REQUIREMENTS

- A. See Section 26 0000.

#### 1.05 COMMON REQUIREMENTS FOR QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years experience.
- B. Installer Qualifications: Engage experienced Installers for Work.
- C. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
  - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.
- D. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide UL Labeled and listed access door assembly with flush door, frame, hinge, and latch from manufacturer listing in the UL "Building Materials Directory" for rating shown.
- E. Standardization of Product Manufacturer:
  - 1. When two or more items of same material or equipment are required they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.
  - 2. Except as noted, switchboard, panelboards, safety switches, and equipment or wiring cabinets shall be manufactured by the same company, finishes shall be the same color, and equipment shall fit the space designated.
  - 3. Except as noted, magnetic starters, manual starters and motor control centers shall be manufactured by the same company, finishes shall be the same color, and all equipment shall fit the space designated.
  - 4. Wiring devices and other items covered under a single specification section, except for light fixtures, shall be of the same manufacturer and style whenever practical or where failure to do so is visibly noticeable.
- F. Material and Workmanship:
  - 1. Materials provided shall be new and shall be approved by the Underwriters Laboratories, Inc., NFPA, NEMA, and ANSI as conforming to its standards in every case where such a standard has been established for such material.
  - 2. Materials shall be standard products of manufacturer's regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design.
  - 3. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
  - 4. Workmanship shall be neat and complete in both effectiveness and appearance and shall be executed by persons licensed and skilled in the trade. Engineer reserves the right to reject any material or workmanship before, during or after construction.
  - 5. Materials and Finishes: Provide adequate corrosion resistance to eliminate staining of exposed surfaces.
  - 6. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- G. Coordination:
  - 1. See also "Quality Assurance" paragraph of Section 26 0000.

2. Discrepancies and omissions discovered during construction shall immediately be called to the attention of the Architect or Engineer for clarification.
  3. Installation of materials shall be coordinated with other trades and installed at such time and manner as to not delay or interfere with the work of other trades.
  4. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections. Determine connection locations and requirements.
  5. Sequence and coordinate work with other trades to avoid conflict of space and time sequence. If interference develops, the matter shall be brought to the attention of the Architect for decision.
  6. Organize the work so that progress of work will conform to the progress of other trades. Give attention to large equipment requiring positioning prior to closing the building.
  7. Complete the entire installation as soon as building conditions permit.
  8. This Contractor shall be held solely responsible for coordinating proper size and location of hangers, slots, chases, openings, etc., required for proper installation of his work and shall arrange with the proper building contractors for inserts, chases, and openings.
  9. Refer to drawings and specifications of other divisions and trades for correlating information, location and details of work, dimensions, etc. Coordinate location of all outlets and equipment. If conflicts develop Architect or Engineer's decision will govern. No additional compensation will be allowed for moving of un-coordinated, misplaced or poorly located outlets, material, equipment or work.
- H. Pre-installation meetings are required as noted in this and other specification sections and are intended to help coordination efforts. Electrical Contractor shall schedule and convene a pre-installation meeting with all affected trades as noted in specifications and on Drawings.
- I. Provide competent representative(s) on site constantly to supervise work from beginning through completion and final acceptance. So far as possible contractor shall keep same foreman and workmen throughout project duration.
- J. During its progress, the work shall be subject to observation by representatives of Owner, Architect and Engineer at which times Contractor shall furnish all required information and cooperation

#### **1.06 SAFETY**

- A. Comply with the requirements of Division 01 and this specification.
- B. Perform work in accordance with NFPA 70E and in compliance with OSHA requirements.
- C. Do not perform work on exposed live electrical equipment. If work is required (as defined by OSHA 29 CFR 1910.333) to be performed on exposed live electrical equipment an energized work permit must be must be prepared (see NFPA 70E for energized work permit requirements) and a Hazard/Risk Analysis in accordance with NFPA 70E and provide appropriate levels of personal protective equipment according to NFPA 70E.
- D. Only Qualified Persons as defined by NFPA 70E shall be allowed to work on exposed live electrical equipment. Observe the safety boundaries defined in NFPA 70E.
- E. Prior to performing work on exposed live electrical equipment convene a safety meeting to address safety hazards specific to the task.
- F. Safety Program: the electrical contractor shall implement and document an electrical safety program in accordance with NFPA 70E and a workplace safety program that complies with the requirements OSHA and NFPA 70E.

#### **1.07 SUBMITTALS FOR REVIEW**

- A. Submit per the requirements of Division 01 and Section 26 0100.

- B. Provide manufacturers installation instructions and product data for:
  - 1. Fire-Resistant Joint Sealers.
  - 2. Sleeves.

#### **1.08 SUBMITTALS FOR INFORMATION**

- A. Submit according to requirements of Division 01 and Section – Electrical General Requirements.
- B. Submit written requests for System Interruptions and Outages as specified herein.
- C. Submit Utility Company prepared drawings two weeks prior to commencing electric service work.
- D. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this section.

#### **1.09 SUBMITTALS FOR CLOSEOUT**

- A. Submit per requirements of Division 01 and Section 26 0100.
- B. Include product information and installation details with O & M manuals for fire resistant joint sealers and fire resistant sleeves.

### **PART 2 PRODUCTS**

#### **2.01 HANGERS AND SUPPORTS**

- A. Anchors and Fasteners:
  - 1. Manufacturers
    - a. RACO.
    - b. Appelton
    - c. Caddy
    - d. B-Line
    - e. Substitutions: Under provisions of Division 01 and Section - Electrical General Requirements.
  - 2. Concrete Structural Elements: Use precast insert system, expansion anchors, powder actuated anchors and preset inserts.
  - 3. Steel Structural Elements: Use beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
  - 4. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
  - 5. Hollow Masonry and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
  - 6. Solid Masonry Walls: Use expansion anchors and preset inserts.
  - 7. Sheet Metal: Use sheet metal screws.
  - 8. Wood Elements: Use wood screws.
- B. Steel Channel:
  - 1. Manufacturers:
    - a. B-Line Systems, Inc.
    - b. Unistrut®.
    - c. Substitutions: Under provisions of Division 01 and Section - Electrical General Requirements.
  - 2. Description:
    - a. Hot dip galvanized where located outdoors and in wet/damp locations.
    - b. Painted steel indoors in dry locations.

- c. Paint cut ends of channel in damp locations.
  - d. Stainless steel or nonmetallic channel as shown on plans.
- C. Spring Steel Clips:
  - 1. Caddy
  - 2. Steel City
  - 3. Substitutions: Under provisions of Division 01 and Section - Electrical General Requirements
- D. Miscellaneous Metals:
  - 1. Steel plates, shapes, bars, and bar grating: ASTM A 36.
  - 2. Cold-Formed Steel Tubing: ASTM A 500.
  - 3. Hot-Rolled Steel Tubing: ASTM A 501.
  - 4. Steel Pipe: ASTM A 53, Schedule 40, welded.
  - 5. Nonshrink, Nonmetallic Grout: Premixed, factory-packed, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.
  - 6. Fasteners: Zinc-coated, type, grade, and class as required.
- E. Miscellaneous Lumber:
  - 1. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
  - 2. Construction Panels: Plywood backboards; APA A-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 3/4 inches.

## **2.02 JOINT SEALERS**

- A. General: Joint sealers, joint fill material, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Engineer from manufacturer's standard colors.
- C. Provide fire resistant joint sealers as specified in Division 07.

## **2.03 SLEEVES**

- A. Sleeves for Raceways and Cables
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized Steel.
  - 2. Rectangular Sleeves: Galvanized Sheet Steel. 16 Gauge for less than 50 square inches and not side longer than 16 inches. 8 gauge for greater than 16 inches or one side more than 16 inches.
- B. Sleeve Seals
  - 1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
    - e. Link Seal.

3. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
4. Pressure Plates: Carbon steel. Include two for each sealing element.
5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element
6. Provide fire rated seals as required. See Division 07.

## **2.04 CONCRETE**

- A. Switchboards, motor control centers and dry type transformers shall be mounted on 3-1/2" high concrete pads furnished by this contractor. Size pads such that pad extends 2" beyond the perimeter of the equipment installed.
- B. Poles provided for mounting exterior light fixtures shall be installed on or in concrete bases provided by the electrical contractor as detailed on drawings.
- C. Exterior pad-mounted transformers, generators and CT Cabinets shall be mounted on concrete pads furnished by this Contractor. Pads shall be sized as required by Utility, size of equipment being installed or as detailed on drawings. Size pads such that pad extends 6" beyond the perimeter of transformers and CT cabinets and 12" for generators.
- D. Concrete shall conform to Division 03 of this specification.

## **PART 3 EXECUTION**

### **3.01 COMMON REQUIREMENTS FOR EXAMINATION PRIOR TO ELECTRICAL INSTALLATIONS**

- A. Verify conditions and constructions types prior to installation.
- B. Verify that surfaces that support Product(s) are ready to receive them.
- C. Examine location of equipment installation for compliance with installation tolerances and other conditions affecting performance of Work
  1. Prepare drawings showing proposed rearrangement of work to meet Project conditions, including changes to work specified in other Divisions. Obtain permission of Architect before proceeding.
- D. Review all Drawings including architectural, mechanical, structural, civil, and electrical drawings for extent of Work.
  1. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
- E. Examine Architectural drawings and elevations to verify device locations and mounting heights.
  1. In finished spaces, where mounting heights are not detailed or dimensioned coordinate mounting height with Architect.
  2. Do not rough-in for any wall mounted equipment without verifying mounting height with Architect unless equipment is specifically noted on Architectural Drawings.
  3. Do not scale dimensions from Electrical Drawings and verify all mounting heights noted on Electrical Drawings.
  4. See preparation, quality assurance, and coordination requirements in section Raceways and Boxes for Electrical Systems for additional information and requirements.
- F. Site Investigation

1. Prior to beginning work, exam the work site to become familiar with existing conditions which may affect the cost of the project. This includes measurements for lengths, quantities, clearances and all other field verifiable conditions.
2. No extra charges will be allowed because of failure of Contractor to become familiar with the existing conditions prior to beginning work.
3. Existing equipment, systems and installations whether they are not detailed on the drawings must be restored to their original condition.

### **3.02 COMMON REQUIREMENTS FOR PREPARATION TO INSTALLATION**

#### **A. Equipment Wiring preparation**

1. Obtain and review shop drawings, product catalog data, etc. prior to roughing-in for electrical connections.
2. Verify dimensions and final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
3. Refer to equipment drawings and specifications in all specification Divisions for rough-in requirements.

#### **B. Electric Utility Service Entrance preparation**

1. Coordinate with Utility Company for installation of radio telemetry unit.
2. Coordinate location of Utility Company's facilities to ensure proper access is available.
3. Provide compression lugs on end of service entrance cable to be terminated at the Utility Company's transformer as required by Utility Company.
4. Verify that field measurements are as indicated on Utility Company drawings.
5. Pre-Installation meeting: Convene two weeks prior to commencing work of this section with Utility Company representative, General Contractor, and other trades affected by site work to coordinate final location of transformer and underground electrical Work.

#### **C. Demolition and remodeling preparation.**

1. Notify the Owner and Architect at least five (5) days prior to commencing demolition operations
2. Demolition Drawings are based on field observation and existing record documents. Report discrepancies to Architect before disturbing existing installation.
3. Verify existing circuiting arrangements and control apparatus and wiring.
4. Verify that abandoned wiring and equipment serve only abandoned facilities.
5. Review existing equipment and materials with the Owner, schedule or indicate equipment to be salvaged for re-use and equipment to be salvaged and turned over to the Owner.
6. Beginning of demolition means Contractor accepts existing conditions.
7. Extension of existing circuits and or systems: Prior to connecting any new Work to existing circuits or systems Contractor shall provide field measurements and surveys required to ensure adequate capacity is available for new connections.

#### **D. Hangers and Supports preparation**

1. Coordinate the installation of required supporting devices, inserts and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed. Strength of construction shall not be impaired.
2. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations. Strength of construction shall not be impaired.
3. Provide fire rated plywood backboards shall be primed and painted with (2) coats of Gray enamel prior to mounting any equipment, wiring, etc. The rating stamp shall remain visible.

### 3.03 COMMON INSTALLATION REQUIREMENTS FOR ELECTRICAL WORK

- A. Description Of Wiring Methods:
  - 1. Wiring shall be installed in accordance with applicable codes and as noted in section 26 0519, unless otherwise indicated.
  - 2. Multi-wire branch circuits shall not be allowed unless specifically noted. Provide separate neutral conductor for each circuit.
  - 3. See Section Low Voltage Electrical Power Conductors and Cables for conductor and cable requirements.
  - 4. See Section Raceways and Boxes for Electrical Systems for box and raceway requirements.
- B. Install products in accordance with NECA 1 and manufacturer's instructions.
- C. Install work in locations shown on drawings, unless prevented by Project conditions. Refer to architectural drawings for exact devices locations.
- D. Conform to arrangements indicated by Contract Documents, recognizing that the Work is shown only in diagrammatic form.
- E. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- F. Install materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- G. Core drilling of concrete is required, where possible, in lieu of hammer drilling. Hammer drilling is generally to be limited to small holes for anchors.
- H. Hangers and Supports
  - 1. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
  - 2. Do not fasten supports to pipes, ducts, mechanical equipment and conduit. Do not drill or cut structural members.
  - 3. Fabricate supports from structural steel or formed steel members. Rigidly weld members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
  - 4. Install surface-mounted cabinets, disconnects, contactors, starters and panelboards with minimum of four anchors.
  - 5. In wet and damp locations use steel channel supports to stand cabinets, disconnects, contactors, starters and panel boards approximately one inch off wall.
- I. Floor, Wall and Ceiling Penetrations
  - 1. Effectively seal penetrations in exterior walls, roofs, and rated interior walls in accordance with Division 07.
  - 2. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access door units. Do not proceed with installation until unsatisfactory conditions have been corrected.
  - 3. Conduits and cables passing through floors, walls, and ceilings at the following locations shall be sealed for sound, heat, smoke and / or moisture control.
    - a. Acoustically rated walls.
    - b. Fire and / or smoke resistant walls and floors.
    - c. Electrical rooms.
    - d. Mechanical rooms.
    - e. Penthouse.



- f. Exterior walls.
  - g. Vertical and horizontal shafts.
  - h. Walls around janitor rooms, receiving rooms, and other facility maintenance and management rooms.
  - i. Food service areas.
4. Where conduits and raceways pass through interior walls and ceilings (not requiring water proofing) provide suitable sealing material complying with Division 07 for the wall construction; examples:
    - i) Plaster for plaster walls.
    - ii) Joint compound for gypsum board walls.
    - iii) Mortar for masonry block and brick walls.
    - iv) Grout for concrete walls.
  5. Place sealing material around each conduit and raceway for the full thickness of the wall.
  6. Where conduits and raceways pass through exterior walls and ceilings below grade, provide installation to meet the details noted on the Drawings.
  7. Where interior walls require waterproof conduit and raceway seals, provide silicone sealant generally installed as specified above for exterior walls.
  8. Where conduits and raceways pass through exterior walls above grade, provide matching wall material inside (see examples above) and provide waterproof seal of silicone sealant or other approved sealant on outside.
  9. At the nearest point of access to wires (inside conduit or raceway) passing through exterior walls and roof; provide "Ductseal" between wires and conduit or raceway as a wind barrier.
  10. Where cables pass through walls, ceilings and floors, generally use same sealing method as for conduits.
  11. "Ductseal" type material is generally not acceptable except as noted above.
  12. Utilize fire rated cabling pathways where cabling must be routed through fire-rated floor and wall assemblies.
- J. Roof Penetrations
1. Electrical Contractor shall be responsible for providing roof seals for each raceway, mast, tower leg, guy wire, etc., which pass through roof, rest on roof or attach to roof. Avoid roof penetrations where possible. This work shall be performed by the Roofing Contractor. Electrical Contractor shall coordinate work as needed.
- K. Cutting, Patching, and Finishing
1. General: Perform cutting, patching and finishing in accordance with Division 01.
    - a. Cut, remove, and legally dispose of material including but not limited to construction material, and other indicated material made obsolete by the new work.
    - b. Protect the structure, furnishings, finishes, and adjacent materials and installations not indicated or scheduled to be cut or removed.
    - c. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt into adjacent areas.
    - d. The Contractor shall not endanger the stability of the structure by cutting, excavation or otherwise.
    - e. Do not cut or alter work of any other trade without trade and Architect / Engineer's consent.
  2. Perform cutting, patching and finishing of walls, floors, ceilings, roofs required to:
    - a. Uncover work to provide for installation of new or ill-timed work.
    - b. Remove and replace defective work.
    - c. Remove samples of installed work as specified for testing.

3. Upon written instructions from the Architect / Engineer, uncover and restore work to provide for Engineer's observation of concealed work.
4. Should any cutting be required for proper installation of electrical work because of failure to give the General Contractor the proper information at the time required, such cutting shall be done at the Electrical Contractors expense.

L. Equipment wiring installation

1. Provide all necessary boxes, raceways, and wiring required to make equipment and systems complete and operable.
2. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings.
3. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components.
4. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
5. Make electrical connections in accordance with equipment manufacturer's instructions.
6. Make conduit connections to equipment using flexible metal conduit. Use liquidtight flexible metal conduit with watertight connectors in damp or wet locations.
7. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
8. Provide suitable receptacle outlet to accommodate connection with attachment plug.
9. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
10. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
11. Install terminal block jumpers to complete equipment wiring requirements.
12. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

### **3.04 DEMOLITION AND REMODELING**

A. General Demolition:

1. Remove, relocate, and extend existing installations to accommodate new construction.
2. Where indicated or required, remove existing electrical systems in walls, floors, and ceilings scheduled for removal.
3. Where abandoned wiring serves equipment and / or facilities not indicated to be removed Contractor shall extend and / or reroute wiring to maintain service to the equipment that shall remain.
4. Repair adjacent construction and finishes damaged during demolition and extension work.
5. Maintain access to existing electrical installations which remain active. Modify installation or provide access door unit as appropriate.

B. Raceway and Box Demolition:

1. Remove all abandoned conduit, unless indicated to remain for re-use or future work, including abandoned conduit exposed during demolition and located above accessible ceilings.
2. Cut concealed abandoned conduit flush with walls and floors that are indicated to remain.
3. Remove abandoned boxes if conduit servicing them is removed.
4. Provide appropriate blank cover for abandoned boxes which are not removed.
5. Disconnect and remove abandoned panelboards and distribution equipment as indicated.

C. Conductor and Cabling Demolition:

1. Remove all abandoned conductors and cabling in their entirety.

- D. Equipment Demolition:
  - 1. Where indicated or required, remove all luminaires, stems, brackets, hangers, supports, etc.
  - 2. Remove, demount, and disconnect existing electrical materials and equipment indicated to be salvaged, and deliver same to the location designated for storage. Leave in good condition and store in orderly manner.
  - 3. Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- E. Maintain existing systems in service until new systems are complete and ready for use.
  - 1. Disable existing systems only to make switchovers and connections.
  - 2. Notify Architect, Construction Manager, and Owner and obtain permission before partially or completely disabling systems.
  - 3. Minimize outage duration and coordinate time with Owner at his convenience.
  - 4. Make temporary connections to maintain service, feeders and branch circuits when outage time exceeds 8 hours or more.

### **3.05 INTERRUPTIONS, ENERGIZATIONS, AND OUTAGES**

- A. Coordinate utility service outages and disconnections with Utility Company.
- B. Provide temporary wiring, connections, and protection as required to maintain all existing systems to remain in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- C. Owner approval is required prior to electric service outages or energizations and shall be scheduled at the convenience of the Owner.
  - 1. A written request must be submitted to the Owner / Architect / Engineer for approval a minimum of 15 days prior to outage or energization.
  - 2. Cancellation of the planned interruption by the Owner for any reason, at any time up to 24 hours before planned interruption shall bear no additional cost to the Owner.
- D. Major Feeder and Service Work Sequence: A minimum of 10 days before the requested outage, submit a schedule of proposed electric feeder and switchboard outages and energizations.
  - 1. Include construction energizations and work performed during other than normal working hours (outside of 7:00 am to 6:00 pm Monday through Friday).
  - 2. Include details of the work to be completed during each outage.
- E. Minimize outage time and provide manpower such that work can be carried out at multiple locations if required.
- F. Outages and / or energizations may require the Contractor to work at other than regular normal working hours. No extra compensation will be allowed for such times.

### **3.06 EQUIPMENT AND DEVICE MOUNTING HEIGHTS**

- A. Coordinate final mounting heights as directed under Part 3 paragraph "Preparation".
- B. Interior mounting heights indicated on drawings are from finished floors (interior) or final grade (exterior). Mounting heights for items indicated on exterior walls are from the interior finished floor below.
- C. Mounting heights indicated are to the top of the device plate unless noted otherwise. Mounting heights are nominal and shall be adjusted to fit block joints.

- D. Typical mounting heights are detailed on the Drawings.
- E. Handicapped counter and lavatory locations: meet ADA requirements for receptacle and switch locations and elevations.
- F. Contractor shall verify mounting heights of all outlets to assure installation above top of radiation covers, mirrors, counters, vanity, cabinets, and any other obstruction that may alter indicated mounting heights. ADA accessible controls must be mounted at 48".

### **3.07 TEMPORARY FACILITIES**

- A. The Contractor shall provide temporary facilities according to Division 01, "TEMPORARY FACILITIES".
- B. Temporary power shall consist of Power Distribution Centers (PDC).
  - 1. Equipment shall be mounted on a ¾" plywood backboard with support legs on both ends with lockable wheels on bottom of legs so that unit is portable. Each PDC shall consist of a the following:
    - a. 200 amp, 120/240 volt, 1-phase, 3-wire panelboard.
    - b. Six 120 volt, 20 amp, quad-plex, GFI receptacles with weatherproof box and cover, each with a dedicated circuit.
    - c. Three 240 volt, single-phase, 30 amp receptacles with weatherproof box and cover.
    - d. One 240 volt, single-phase, 50 amp receptacle with weatherproof box and cover.
  - 2. All equipment shall be grounded per the National Electrical Code, 2014 Edition, NFPA 70.
  - 3. Relocate equipment as necessary to allow construction to continue.
  - 4. Provide GFI protection as required by OSHA. Use GFI receptacles in lieu of circuit breakers whenever possible.
  - 5. Welders, temporary heat-blowers, etc. shall be hardwired as needed.
- C. Provide temporary lighting with local switching that provides adequate illumination for construction operations as follows:
  - 1. Incandescent light fixtures with wireguards or halogen floodlights are acceptable.
  - 2. Provide a suitable quantity of fixtures to achieve a continuous light level of 15 footcandles for all interior access routes throughout the buildings and in stairwells. Additional temporary lighting shall be provided in mechanical rooms, electrical rooms, kitchens, and rooms over 1000 square feet. Temporary task lighting in individual rooms is the responsibility of individual contractors.
  - 3. Provide night time flood lighting for all excavations and exterior access routes within the construction zone.
  - 4. Relocate lighting as required to allow construction to continue.
- D. Under no condition shall permanent lighting fixtures or electric heating units be used for temporary lighting or heat, unless approved in writing by Engineer.
- E. Temporary lighting and power systems shall be approved by authority having jurisdiction.

### **3.08 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Furnish, without additional expense to the Owner, the services of competent instructors, who will give full instructions in the care, adjustment and operation of all parts of the electrical equipment to the Owner's employees who are to have charge of the equipment. Including but not limited to the following:
  - 1. Demonstrate the proper operation of systems per the operational and function requirements of the Contract Documents and as outlined in any sequence of operation.
  - 2. Instruct personnel, in all phases of operation, location of components and use of all systems.
  - 3. Review manufacturer Warranty information for all equipment included in the manual.

- B. Number of hours of instruction shall be specified in other sections of this specification.
- C. An operating and maintenance manual shall be made available to the Owner's operating personnel during the instruction and left with the Owner upon completion of the instruction.
- D. Owner instruction / demonstration shall be provided as noted below and as noted in specification sections (see individual specification section for additional requirements):
  - 1. Low Voltage Electrical Conductors and Cables – indicate manufacturer's recommendations for tightening and checking bolted connections.
  - 2. Grounding and Bonding – review building grounding and bonding systems.
  - 3. Identification for Electrical Systems – review naming conventions, color schemes, warning labels, posted operating instructions, bolted connection labels, etc.
  - 4. Lighting Control Devices – see specification section.
  - 5. Electrical Distribution Equipment – provide overview of system, highlight major components and distribution equipment. Review suggested maintenance schedules.
  - 6. Wiring Devices – review maintenance requirements (e.g. GFCI monthly test requirements).
  - 7. Electric Space Heating Units – review control device locations, programming, and settings.
  - 8. Packaged Engine Generator Set - see specification section.
  - 9. Enclosed Transfer Switches - see specification section.
  - 10. Surge Protective Devices – review locations, alarm indicating lights, and maintenance procedures to follow alarms are indicated.
  - 11. Lighting Fixtures and Luminaires – review lamp changing requirements for all fixture types.
- E. Documentation: Upon completion of Owner Instruction and Demonstration provide a certificate signed and dated by the attendees indicating information covered, amount of instruction / demonstration time provided, and applicable specification sections. Provide certificate for all Owner Instruction and Demonstration sessions. Include copy with O & M Manual. A sample certificate is attached for reference.

### **3.09 FIELD QUALITY CONTROL**

- A. So far as possible contractor shall keep same foreman and workmen throughout project duration. Keep enough workmen on job to insure keeping up with or ahead of other trades so that no delays occur.
- B. Delivery, Storage, and Handling
  - 1. Deliver, store, protect and handle products on site under provisions of Division 01 according to manufacturer's recommendations and as specified herein.
  - 2. This Contractor shall make provisions for delivery and safe storage of materials.
  - 3. Accept Products on site. Inspect for damage
  - 4. Protect Products from corrosion and entrance of debris. Provide appropriate covering. During construction, it shall be the responsibility of this Contractor to protect the surface of equipment and material furnished.
  - 5. See individual specifications sections for specific delivery, storage, handling and protection requirements.

### **3.10 CLEAN-UP, KEY CONTROL, AND PAINTING**

- A. Remove all packing materials, rubbish, debris, etc. from the site each day.
- B. String all furnished keys on split metal key ring and turn same over to Owner at project completion.

### **END OF SECTION**



# **SECTION 26 0519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Building wire and cable rated 600V and less.
- B. Wiring connectors and connections rated 600V and less.
- C. Sleeves for Cables.

### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26, 27, and 28.
- B. See Section 26 0100 Electrical Systems Close Out Documentation.
- C. See Section 26 0500 Common Work Results for Electrical. Specifically reference description of wiring methods indicated in part 3 paragraph Common Installation Requirements for Electrical Work.
- D. See Section 26 0533 Raceway and Boxes for Electrical Systems.
- E. See Section 26 0553 Identification for Electrical Systems.
- F. See Section 26 0100 Electrical Systems Close Out Documentation.
- G. See Section 26 0813 Testing of Electrical Systems.
- H. See Section 26 0920 Lighting Control Devices and Systems.
- I. See Section 27 0528 Pathways for Communications Systems.
- J. See Section 27 1000 Communication Structured Cabling Systems for voice, data, and cable TV wiring.
- K. See Section 28 3116 Fire Alarm and Detection System Extensions.

### **1.03 REFERENCES**

- A. Division 01 - Quality Control and Reference Standards: Requirements for references and standards.
- B. Federal Specifications Standards and Test Methods A-A-59544 – Cable and Wire Electrical (Fixed Installation).
- C. NECA Standard of Installation (National Electrical Contractors Association).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- E. NFPA 70 - National Electrical Code.
- F. NEMA WC 70 - Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
- G. UL Standards:

1. UL 44 - Thermoset-Insulated Wires and Cables.
2. UL 83 - Thermoplastic-Insulated Wires and Cables.
3. UL 1063- Machine-Tool Wires and Cables.
4. UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords.
5. UL 1479 Standard for Fire Tests of Through-Penetration Firestops.
6. UL 1569 Standard for Metal-Clad Cables.

#### 1.04 DESCRIPTION OF SYSTEM

- A. Conductor and conduit sizes noted are based on type THHN copper unless noted otherwise.
- B. Conductor material applications:
  1. Feeders for panelboards, switchboards, and other distribution equipment: Copper. Aluminum Conductors are not acceptable.
  2. Motor Feeders: Copper. Aluminum Conductors are not acceptable.
  3. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
    - a. Use stranded conductors for control circuits.
    - b. Use conductor not smaller than 12 AWG for power and lighting circuits.
    - c. Use conductor not smaller than 16 AWG for control circuits.
    - d. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.
    - e. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.
- C. Wiring Methods
  1. See Section 26 0533 for raceway system requirements.
  2. Service Entrance: Type THHN-THWN single conductors in raceway or Type XHHW-2, single conductors in raceway.
  3. Feeders for panelboards, switchboards, and other distribution equipment: Type THHN-THWN or XHHW-2 single conductors in raceway.
  4. Feeders for panelboards, switchboards, and other distribution equipment: Type THHN-THWN single conductors in raceway or multi-conductor cable Type MC.
  5. Motor Feeders: Type THHN-THWN or XHHW-2 single conductors in raceway.
  6. Motor Feeders: Type THHN-THWN single conductors in raceway or multi-conductor cable Type MC.
  7. Branch Circuits:
    - a. Multi-wire branch circuits shall not be acceptable. Provide dedicated neutral conductor for each circuit.
    - b. Home Runs (from circuit breaker to junction box at accessible location adjacent to first wiring device): Type THHN-THWN single conductors in raceway.
    - c. Exposed (including in crawl spaces, electrical rooms, mechanical rooms, and above accessible ceilings): Type THHN-THWN single conductors in raceway.
    - d. Concealed (e.g. in ceilings, walls, partitions): Type THHN-THWN single conductors in raceway.
    - e. Concealed (e.g. in ceilings, walls, partitions): Type THHN-THWN single conductors in raceway or multi-conductor cable Type MC.
      - i) MC cable is generally permitted to installed concealed within walls or above ceilings only. Limit exposed runs of MC cable above accessible ceilings to 8' and install parallel or perpendicular to building lines.
      - ii) Home runs to be single conductors in raceway, and each home run shall have a junction box installed above the accessible ceiling.
      - iii) Type MC cable shall not be installed where it is subject to physical damage.
    - f. Within Dwelling Units: Use Nonmetallic-Sheathed Cable.
    - g. Direct Burial (Outdoors): Direct buried cables are not acceptable.



8. Wiring for Variable Frequency Drives:
  - a. Input to the VFD: Copper, 600V, 90 degree C, THHN, THWN-2, XHHW2, RHH, or RHW-2. Single conductors in conduit.
  - b. Output from VFD to equipment: Copper, 600V, 90 degree C, XHHW2. Single conductors in metallic conduit.
9. Cord Drops and Portable Appliance Connections:
  - a. Indoors kitchen and similar environments: Type SO, hard service cord.
  - b. Indoors shop and similar environments Type STO, thermoplastic, hard service cord.
  - c. Outdoors Type STOW-A, thermoplastic, hard service, weather resistant cord.
  - d. Include stainless, wire-mesh, strain relief device at terminations to suit applications.
10. Class 1 Control Circuits: Type THHN-THWN single conductors in raceway.
11. Class 2 Control Circuits:
  - a. For lighting control devices (occupancy sensors, low-voltage switches, etc.), exposed multi-conductor cable, plenum rated shall be acceptable in concealed locations. Install cabling in accordance with Section 27 0528.
  - b. Unless otherwise noted all other locations use type THHN-THWN single conductors in raceway.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 5 years documented experience.
- B. Manufacturer: Type MC Cables and wire shall be supplied from a single manufacturer.
- C. Furnish products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- D. Do not install conductors until building finishes are complete. If construction schedule requires conductors to be installed prior to finishes this contractor shall protect conductors from paint and other debris or damage.
- E. Protect products from moisture and damage by storing them in a clean, dry location remote from areas involved in construction operations. Provide additional protection in accordance with manufacturer's instructions.

#### **1.06 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 01 and Section 26 0000 – Electrical General Requirements.
- B. Product Data: Submit manufacturer's product data indicating that materials comply with specified requirements and are suitable for intended application.

#### **1.07 SUBMITTALS FOR INFORMATION**

- A. Submit according to the requirements of Division 01 and Section 26 0000 – Electrical General Requirements.
- B. Installation Instructions: Manufacturer's installation instructions shall be included in submittal. Industry guides may supplement the manufacturer's instructions.
- C. For Coordination submit Drawings showing proposed routing of all feeders and branch circuits larger than 90-amps. Ensure routes are shown and coordinated with mechanical (ductwork, piping, etc.) and structural elements.

## 1.08 SUBMITTALS FOR CLOSEOUT

- A. Submit according to the requirements of Division 01 and Section 260100.
- B. As-Built Documents: Record actual locations of components and circuits. Indicate route of all feeders.
- C. Operation and Maintenance Manuals:
  - 1. Include copy of submittals for review.
  - 2. Include copy of submittals for information.
  - 3. Include documentation described in Part 3 of this specification section and information specified in Section 26 0100.
  - 4. Submit manufacturer's recommended maintenance procedures for cables, splices, and terminations.

## PART 2 PRODUCTS

### 2.01 CONDUCTORS AND CABLES

- A. Manufacturers:
  - 1. AFC Cable Systems Inc. (Multiconductor cable)
  - 2. Alcan Products Corp. (Aluminum cable)
  - 3. Alflex Corp. (Southwire)
  - 4. American Insulated Wire Corp.
  - 5. American Wire Group
  - 6. Cerrowire
  - 7. Coleman Cable, Inc.
  - 8. Encore Wire, Ltd.
  - 9. Essex Cable Company
  - 10. Service Wire Co.
  - 11. Substitutions under provision of Division 01 and Section – Electrical General Requirements.
- B. Copper conductors (THHN/THWN):
  - 1. Comply with NEMA WC 70, NFPA 70, and UL 83 or UL 44, UL 1063, UL 1581.
  - 2. Type THHN cable shall meet all applicable ASTM standards
  - 3. Type THHN cable shall meet Federal Specification A-A-59544.
  - 4. UL listed sunlight resistant in black sizes 2AWG and larger. Sizes 1/0 and larger listed for CT USE. Sizes 14 through 1 AWG shall be rated VW-1. Sizes 8 AWG and larger shall be rated THWN-2.
  - 5. Sizes 14 AWG and 12 AWG shall be solid and 10 AWG may be either solid or stranded, 8 AWG and larger are stranded.
  - 6. Conductor shall be soft annealed copper.
  - 7. Insulation shall be high-heat and moisture resistant PVC.
  - 8. Jacket shall be abrasion, moisture, gasoline and oil resistant or listed equivalent.
  - 9. Self-lubricating Jacket: Jackets on conductors sizes 2 and larger shall be Southwire "SIMpull" or equivalent with integrated self-lubrication.
- C. Type MC Cable:
  - 1. Comply with the following:
    - a. UL 1569 Standard for Metal-Clad Cables (specifically provisions of Section 6.1.5A).
    - b. UL Standard 83 for Thermoplastic-Insulated Wires and Cables or UL Standard 44 for Thermoset-Insulated Wires and Cables.
    - c. UL Standard 1479 Standard for Fire Tests of Through-Penetration Firestops.
    - d. UL Classified 1, 2, and 3 Hour Through-Penetration Firestop Systems.

2. Cable Construction:

- a. Conductors shall be color coded for 120/208 and 277/480 volt systems.
- b. For Circuits: Conductors are made from class B copper. Sizes 14 AWG and 12 AWG shall be solid and 10 AWG may be either solid or stranded, 8 AWG and larger are stranded. Ground conductor shall be copper. Grounding Conductor shall have green insulation and be cabled with the phase conductors. Where noted or indicated on Drawings provide an additional grounding conductor for isolated or redundant grounding. Cable shall have a neutral conductor per phase.
- c. For Feeders Only: Conductors are made from class B copper. Ground conductor shall be copper. Grounding Conductor shall have green insulation and be cabled with the phase conductors. The ground conductor may be green or bare depending on size of conductor.
- d. Insulation: THHN/THWN or XHHW-2, rated for 90°C dry or wet at 600 volts max.
- e. Ground Conductor:
  - i) For circuit applications size of grounding conductor shall be based on the rating of the over-current device.
  - ii) For service application grounding conductor size shall be sized based on the largest phase conductor.
  - iii) For feeder applications size of grounding conductor shall be based on the rating of the over-current device.
  - iv) When parallel runs of Type MC cable are needed for a circuit, the equipment grounding conductor should be sized in accordance with Article 250.122 of the National Electrical Code.

D. Multiconductor Cables: Nonmetallic sheathed cable Type NM with ground wire.

E. Cord: Comply with NFPA 70, multi-conductor flexible cord with green insulated equipment grounding conductor. Ampacity of equipment rating plus 30 percent minimum.

1. See part 1 paragraph Description of System for cord types to be used.

## 2.02 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems Inc.
2. AMP
3. 3M
4. Burndy
5. Ideal Industrial Inc.
6. IlSCO
7. Kearney
8. Panduit
9. Tyco Electronics Corp.
10. Wago
11. Substitutions under provision of Division 01 and Section - Electrical General Requirements.

B. Factory fabricated connectors and splices of size, ampacity rating, material type, and class for application and service indicated.

C. Connections for Conductors:

1. Mechanical Screw Type Connectors:

- a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with aluminum and copper conductors and sized to accept aluminum conductors of the ampacity specified. Connectors shall be Burndy Unitap, IlSCO NIMBUS4FLEX, or approved equal.

2. Mechanical Compression Type Connectors:

- a. Connectors shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with aluminum and copper conductors and sized to accept aluminum conductors of the ampacity specified.
  - b. The lugs shall be marked with wire size, die index, number and location of crimps and shall be suitably color-coded. Lug barrel shall be factory prefilled with a joint compound Listed by UL.
3. Termination of Conductor to Aluminum Bus:
- a. Hardware:
    - i) Bolts: Anodized alloy 2024-T4 and conforming to ANSI B18.2.1 and to ASTM B211 or B221 chemical and mechanical property limits.
    - ii) Nuts: Aluminum alloy 6061-T6 or 6262-T9 and conforming to ANSI B18.2.2.
    - iii) Washers: Flat aluminum alloy 2024-T4, Type A plain, standard wide series conforming to ANSI B27.2.
4. Termination of Conductor to Copper Bus:
- a. Hardware:
    - i) Bolts: Plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to ASTM A-325 or SAE grade 5.
    - ii) Nuts: Heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B.
    - iii) Washers: Should be steel, Type A plain standard wide series conforming to ANSI B27.2.
    - iv) Belleville conical spring washers: Shall be of hardened steel, cadmium plated or silicone bronze.
5. Re-usable / Re-enterable splices
- a. Equal to Tyco GelCap SL.
  - b. Moisture sealant temperature rating -40 degrees C to 105 degrees C.
  - c. Clear cap to allow visual inspection.
  - d. Two ports accept wires from #14 to #2/0 AWG.
  - e. Single port accepts #14 to #6 AWG.
  - f. Reenterable.

### **2.03 MISCELLANEOUS PRODUCTS**

- A. Cable Ties: Self-extinguishing, one-piece, self-locking, fungus inert, type 6/6 nylon. Minimum 3/16" wide. Black except if used for color coding.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Coordination and Meetings under provisions of Division 01 and Section - Electrical General Requirements, verify existing conditions before starting work.
- B. Verify that interior of building has been protected from weather.
- C. Verify that mechanical work likely to damage wire and cable has been completed.
- D. Verify that raceway installation is complete and supported.
- E. Wire and cable routing indicated is approximate unless dimensioned.
- F. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

### 3.02 PREPARATION

- A. Verify that field measurements are as indicated.
- B. Wire and cable routing indicated is approximate unless dimensioned. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- C. Review any non-standard and existing color codes with Owner's personnel prior to beginning installation.
- D. Obtain and review Manufacturer's installation instructions for all cable types. Review procedures with installation personnel.

### 3.03 INSTALLATION

- A. Install cable in accordance with the NECA "Standard of Installation" and with manufacturer's instructions.
  - 1. Protect exposed cable from damage.
  - 2. Pull all conductors into raceway at same time.
  - 3. Neatly train and lace wiring inside boxes, equipment, and panelboards.
  - 4. Neatly group wiring inside panelboards according to NEC requirements.
  - 5. Clean conductor surfaces before installing lugs and connectors.
  - 6. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
  - 7. Use suitable cable fittings and connectors.
  - 8. Using a suitable stripping tool, to avoid damage to the conductor, remove insulation from the required length of the conductor
  - 9. Tighten bolted electrical connections to tightness (torque level) suggested by the manufacturer. If manufacturer recommendations are not provided utilize values published in NETA ATS.
- B. Conceal cables in finished walls, ceilings, and floors unless indicated otherwise.
  - 1. Conceal all cables and raceways at cabinetry / millwork.
  - 2. Conceal all cables leading to under cabinet lights.
- C. Above accessible ceiling, use spring metal clips or plastic cable ties to support cables from structure; do not rest cable on ceiling panels.
- D. At light pole bases utilize re-enterable, re-useable splices.
- E. Connections for Copper Conductors:
  - 1. Use pre-insulated mechanical screw type multiple tap connectors for splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector parts with electrical tape to 150 percent of insulation rating of conductor.
  - 2. For 10 AWG and smaller copper conductor splices and taps use insulated spring wire connectors with plastic caps 10 AWG and smaller. For 12 AWG and smaller copper conductors, approved push in connectors, Wago "Wall-Nuts" or approved equal, may also be used.
- F. MC Cable installation:
  - 1. Provide insulated (anti-short) bushing for MC cable.
  - 2. Install MC cable with an armored cable rotary cutter.
  - 3. Support cables according to NEC and manufacturer's instructions and these specifications. Cables shall be secured and supported at intervals not to exceed four (4) feet.
  - 4. The radius of the curve of the inner edge of any bend should not be less than seven times the cable diameter.
  - 5. The maximum sidewall pressure should not be greater than 500 pounds.

G. Identification

1. Where multiple neutral conductors are installed within a single conduit provide neutral conductors with a tracer (color corresponding to the color of the phase conductor).
2. Identify and color code wire and cable in accordance with Section 26 0553 – Identification for Electrical Systems.
3. Provide marking at bolted connections in accordance with Section 26 0553 – Identification for Electrical Systems.

**3.04 FIELD QUALITY CONTROL**

- A. Field quality control, inspection, testing, and adjusting: under provisions of Division 01 and Section – Electrical Testing.
- B. Performance Verification Testing:
1. Perform visual and mechanical inspections listed in NETA Acceptance Testing Specifications (ATS) 2007. Perform investigation and make adjustments to improve results.
    - a. Compare cable data with drawings and specifications. Ensure that VFDs are connected with XHHW-2.
    - b. Inspect bolted connections with one of the approved methods listed in NETA ATS.
      - i) Ohmmeter.
      - ii) Calibrated torque-wrench.
      - iii) Thermographic survey.
    - c. Inspect compression connectors for correct cable match and indentation.
    - d. Inspect for correct identification and arrangements.
    - e. Inspect cable jacket and insulation condition.
  2. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements:
    - a. Test service, feeders, branch circuits, and control circuits to determine continuity of wiring and connections.
    - b. Phase Relationship: Check connections to equipment for proper phase rotation.

**3.05 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Provide Owner Training and Demonstration in accordance with the requirements of Division 01 and as noted below.
- B. Review manufacturer’s recommendations for tightening and checking bolted connections.
- C. Review procedures for properly tightening bolted electrical connections.
- D. Review conductor color code.

**3.06 DOCUMENTATION**

- A. Documentation of Owner Training: See Section 26 0100 for documentation form.
- B. Include a test report complying with the requirements of specification Section 26 0813 Testing of Electrical Systems.

**END OF SECTION**

# **SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Common ground bonding with Lightning Protection System.
- D. Access floor grounding grid.
- E. Bonding.

### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and other sections of Division 26, 27, and 28.
- B. This section is related to the other sections of Division 26, 27 and 28.
- C. See Section 26 0100 Electrical Systems Close Out Documentation.
- D. Section 26 4100 – Lightning Protection System.
- E. Section 27 1000 – Communication Structured Cabling System.

### **1.03 REFERENCES**

- A. Division 01 - Quality Control: Requirements for references and standards.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- C. ANSI/NFPA 70 - National Electrical Code.
- D. UL 467 – Grounding and Bonding Equipment.

### **1.04 DESCRIPTION OF GROUNDING ELECTRODE SYSTEM**

- A. Grounding electrode system refers to electrodes required by NEC including the following:
  - 1. Metal underground water pipe.
  - 2. Metal frame of the building.
  - 3. Concrete-encased (foundation) electrode.
  - 4. Rod electrode(s).
- B. Grounding System Resistance (i.e. resistance between the main grounding electrode system and ground) Performance Requirements: 5 ohms.
- C. Point to Point resistance between main grounding system and the following points shall not exceed 0.5 ohms.
  - 1. Switchboard frames.
  - 2. Panelboard frames.
  - 3. Transformer frames.
  - 4. Telecommunications main ground bus and telecommunications ground bus(es).

5. System and derived neutrals.

#### **1.05 REGULATORY REQUIREMENTS**

- A. The grounding electrode system, bonding, and equipment grounding shall meet the requirements of NEC Article 250 and these specifications

#### **1.06 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories shall be Listed and labeled as defined in NFPA 70 by a testing agency acceptable to Authority Having Jurisdiction, and marked for intended use.
- B. Comply with UL 467.

#### **1.07 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 01 and Section 26 0000 – Electrical General Requirements.
- B. Provide manufacturers catalog data for the following:
  1. Rod Electrode.
  2. Chemically-Enhanced Grounding Electrode: Mechanical Connectors.
  3. Exothermic Connections.

#### **1.08 SUBMITTALS FOR INFORMATION**

- A. Submit according to the requirements of Division 01 and Section 26 0100.
- B. Submit coordination Drawings showing:
  1. Location of connection points to concrete encased electrode.
  2. Location of connection point to lightning protection system.
- C. Within two weeks of installing ground system submit test reports.
- D. Within two weeks of completing wiring / connecting distribution equipment submit test reports.
- E. Within two weeks of installing TMGB and TGB submit test report.

#### **1.09 SUBMITTALS FOR CLOSEOUT**

- A. Submit according to the requirements of Division 01 and Section 26 0100 – Operation and Maintenance of Electrical Systems.
- B. As-Built Documents.
  1. Location of connection points to concrete encased electrode.
  2. Location of ground rods.
  3. Location of grounding / bonding plates.
- C. Operation and Maintenance Manuals:
  1. Include copy of submittals for review.
  2. Include copy of submittals for information.
  3. Include documentation described in Part 3 and information specified in Section 26 0100.



## **PART 2 PRODUCTS**

### **2.01 ROD ELECTRODE**

- A. Manufacturers:
  - 1. Burndy Corp.
  - 2. ITT-Blackburn.
  - 3. Kearney.
  - 4. O-Z/Gedney.
  - 5. Steel City.
  - 6. Thomas & Betts.
  - 7. Substitutions under provisions of Section - Electrical General Requirements.
- B. Material: Copper-clad steel.
- C. Dimensions: Diameter: 5/8 inch. Length: 8 feet.

### **2.02 CONNECTORS**

- A. Manufacturers:
  - 1. Burndy Corp.
  - 2. Kearney.
  - 3. O-Z/Gedney.
  - 4. T & B.
  - 5. 3M.
  - 6. Cadweld
  - 7. Substitutions under provisions of Section - Electrical General Requirements.
- B. Listed and labeled by a nationally recognized testing laboratory acceptable to authority having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure type, with at least two bolts.
- D. Pipe Connectors: Clamp type, sized for pipe.
- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

### **2.03 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. Bonding Cable: 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor
  - 5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 6. Main Bonding Jumper: stranded copper conductors sized as indicated on Drawings.
  - 7. Grounding Electrode Conductor: stranded copper conductor size to meet NFPA 70 requirements.

8. Common Grounding Electrode Conductor: stranded copper conductors sized as indicated on Drawings.
  9. Concrete-encased (Foundation) Electrodes: 4/0 AWG, 20' long or equivalent rebar.
  10. Counterpoise: #3/0 buried minimum of 30" deep.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 4 inch cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Standoff 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, unless otherwise indicated. Length as indicated on Drawing

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

### **3.02 APPLICATIONS:**

A. Conductor Material Application:

1. Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless indicated otherwise.
2. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

B. Conductor Terminations and Connections:

1. Connect bare-cable grounding conductors to ground rods by means of exothermic welds unless indicated otherwise.
2. Underground Connections: Exothermic welds.
3. Connections to Structural Steel: Mechanical connectors.
4. Make exothermic connections without damaging the copper coating or exposing the steel.

### **3.03 INSTALLATION**

- A. Install Products in accordance with manufacturer's instructions.

B. Grounding Electrode Conductors:

1. Route grounding electrode conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
2. Protect grounding electrode conductors within EMT where exposed to physical damage including anywhere below 10' above finished floor.

C. Grounding Bus:

1. Provide an intersystem bonding and grounding bus external to the service equipment enclosures and connect to the to an equipment grounding conductor in the service equipment switchboard with a #4 AWG conductor. See main grounding bus detail on Drawings.
2. Install in communications equipment rooms and other rooms where indicated. Connect to the intersystem bonding and grounding bus with a #4 AWG conductor. See grounding bus detail on Drawings.
3. Install bus on insulated spacers minimum 1 inch from wall, 6 inches above finished floor, unless indicated otherwise.

- D. Grounding Electrode System: Grounding electrodes described below, and those described the NEC Article 250 shall be bonded together to form the grounding electrode system.
1. Steel Building Structure.
  2. Concrete Encased Grounding Electrode: NFPA 70, minimum 20 feet of No. 4 AWG or larger bare copper conductor.
    - a. If foundation is less than 20' coil excess conductor within foundation.
    - b. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.
    - c. Extend grounding conductor to external ground rod, or to building grounding system.
  3. Metallic Underground Water Service Pipe which complies with NEC Article 250.
    - a. Provide insulated copper grounding conductors in conduit from the building main service equipment, or the ground bus, to main metallic water service entrances to the building.
    - b. Connect grounding conductors to the main metallic water service pipes by means of ground clamps.
    - c. Where a dielectric main water fitting is installed, connect the grounding conductor to the street side of the fitting. Do not install a grounding jumper around dielectric fittings.
    - d. Bond the grounding conductor conduit to the conductor at each end.
    - e. Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- E. Ground Rods: Drive rods until tops are 3 inches below finished floor or final grade except as otherwise indicated.
1. Install rod electrodes at locations indicated or as required by AHJ.
  2. For grounding electrode systems, install at least three rods.
  3. Install additional rod electrodes as required to achieve specified resistance to ground.
  4. Locate additional ground rods a minimum of one rod length from adjacent rods and at least the same distance from any other grounding electrode.
  5. Interconnect ground rods with bare conductors buried at least 24 inches below grade.
  6. Provide grounding well pipe with cover at each rod location. Install well pipe cover flush with finished grade.
- F. Braided and Flexible Strap Type Bonding Jumpers:
1. Install to connect grounding clamps on water meter piping to bypass water meters electrically
  2. Use for bonding of equipment mounted on vibration isolation hangers and supports so that vibration is not transmitted to rigidly mounted equipment.
  3. Use elsewhere where flexible bonding and grounding connections are required.
- G. Bonding
1. Bond the non-current carrying parts of:
    - a. Service, feeder, and branch circuit raceways, enclosures, and frames.
    - b. Cable tray.
    - c. Other non-current carrying parts for power, lighting and control systems.
    - d. Bond the interior metal water piping.
    - e. Bond other interior metal piping (including gas piping) likely to become energized.
    - f. Bond Interior Metal Ducts: Bond interior metal air ducts to likely to become energized.
    - g. Bond together metal siding not attached to grounded structure; bond to ground.
    - h. Bond metal poles supporting outdoor lighting fixtures to a grounding electrode at the pole in addition to providing separate equipment grounding conductor.
  2. Neutral grounded conductors shall be completely isolated throughout the system except where required to be bonded to the grounding electrode system in accordance with NEC Article 250.

Contractor shall provide a small loop in the single bonding conductor between neutral grounded conductor and grounding electrode system to accommodate testing with an AEMC Model 3711 clamp-on ground resistance tester. Where bonding straps or screws are provided as part of the manufacturer' product, straps shall be replaced with bonding conductors and lugs.

#### H. Equipment Grounding

1. Comply with NEC Article 250 for equipment grounding and the following.
2. Install separate continuous green insulated copper equipment grounding conductors with feeders and circuits in addition to those locations where required by NEC.
3. Terminate equipment grounding conductors to suitable dedicated lug, bus or dedicated green screw. (Do not use equipment mounting screws or bolts.)
4. Dry-Type Transformers: Install an insulated grounding conductor from the common point of connection of the transformer secondary neutral point and the transformer enclosure to the following:
  - a. The nearest grounding electrode per NFPA 70, including but not limited to building steel where available.
  - b. The grounding bus of the common electrode grounding system, located in the electrical equipment room.

#### I. Communication and Electronic Safety and Security Systems Grounding

1. Provide a #6 AWG equipment grounding conductor from the nearest grounding bus to the telephone service entrance cable protector.
2. Provide a #6 AWG equipment grounding conductor from the nearest grounding bus to the television service entrance cable protector.
3. Provide a #8 AWG equipment grounding conductor from the nearest grounding bus to the fire alarm control panel.
4. Provide a #10 AWG equipment grounding conductor from the nearest grounding bus to the intercom system equipment rack.
5. Provide a #10 AWG equipment grounding conductor from the nearest grounding bus to the communications equipment racks, cabinets, and enclosures.
6. Provide a #10 AWG equipment grounding conductor from the nearest grounding bus to the cable tray system.

### 3.04 FIELD QUALITY CONTROL

#### A. Performance Verification Testing:

1. General: Comply with applicable standards of the National Electrical Testing Association (NETA) including Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" and the requirements of specification section Testing of Electrical Systems.
2. Perform visual and mechanical inspections listed in NETA Acceptance Testing Specifications.
  - a. Verify ground system is in compliance with drawings, specifications, and NFPA 70 article 250.
  - b. Inspect physical and mechanical condition.
  - c. Inspect bolted connections with one of the approved methods listed in NETA ATS.
    - i) Ohmmeter.
    - ii) Calibrated torque-wrench.
  - d. Inspect anchorage.
3. Perform electrical tests listed in NETA Acceptance Testing Specifications.
  - a. Perform resistance measurements at bolted connections with low resistance ohmmeter.

- b. Perform fall-of-potential or alternative test at each point of the system where a maximum ground resistance is level is specified. Comply with IEEE 81.
- c. Perform point to point tests to resistance between main grounding system and points indicated in part 1 above.

### **3.05 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Provide Owner Training and Demonstration in accordance with the requirements of Division 01 and as noted below.
- B. Review building's grounding and bonding systems and location of major components.
- C. Review test procedures and results.

### **3.06 DOCUMENTATION**

- A. Documentation of Owner Training: See Section 26 0100 for documentation form.
- B. Upon request provide a list of all equipment with bolted connections indicating manufacturer's recommended torque value, date of initial tightening, date of test / inspection, name of initial and test / inspection personnel.
- C. Include a test report complying with the requirements of specification Section 26 0813 Testing of Electrical Systems. Report shall indicate results of visual and mechanical inspections as well as results of electrical tests. Include observations of weather and other phenomena that may affect test results. Describe modification measures taken to improve test results.

### **END OF SECTION**



## **SECTION 26 0533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Boxes:
  - 1. Wall and ceiling outlet boxes.
  - 2. Pull and junction boxes.
  - 3. Recessed back box for monitor locations.
  - 4. Nonmetallic curved lid box.
  
- B. Raceway, fittings, and conduit bodies.
  - 1. Galvanized steel rigid metal conduit.
  - 2. Galvanized intermediate rigid metal conduit.
  - 3. Rigid Aluminum Conduit.
  - 4. PVC coated steel rigid metal conduit
  - 5. PVC coated aluminum rigid metal conduit.
  - 6. Flexible Steel Conduit (FMC)
  - 7. Liquidtight flexible steel conduit (LFMC)
  - 8. Electrical metallic steel tubing (EMT).
  - 9. Rigid Polyvinyl Chloride (PVC) conduit.
  - 10. Stainless steel rigid metal conduit (RMC-SS).
  - 11. Stainless steel intermediate metal conduit (IMC-SS).
  - 12. Stainless steel electrical metallic tubing (EMT-SS).
  
- C. Floor Boxes:
  - 1. Cast in place floor boxes.
  - 2. Poke thru box assemblies.
  - 3. Access floor box.
  - 4. Convention floor boxes (multi-utility floor boxes used to house and protect power devices).
  
- D. Surface metal raceway, wireway

#### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and other sections of Division 26, 27, and 28.
- B. Division 07 (Section 07 8400) – Firestopping.
- C. See Section 26 0100 Electrical Systems Close Out Documentation.
- D. See Section 26 0500 Common Work Results for Electrical for hangars and supports.
- E. See Section 26 0519 Low Voltage Electrical Conductors and Cables.
- F. See Section 26 0526 Grounding and Bonding for Electrical Systems.
- G. See Section 26 0553 Identification for Electrical Systems.
- H. See Section 26 0560 Underground Work for Electrical Systems.
- I. See Section 26 2726 Wiring Devices for wall plates and installation requirements.

- J. See Section 27 0528 Pathways for Communication Systems.
- K. See Section 28 3116 Fire Alarm and Detection System Extensions.

### 1.03 REFERENCES

#### A. ANSI References:

1. ANSI C80.1 – Electrical Rigid Steel Conduit (ERSC).
2. ANSI C80.3 – Electrical Metallic Tubing (EMT).
3. ANSI C80.5 – Electrical Rigid Aluminum Conduit (ERAC).
4. ANSI C80.6 – Electrical Intermediate Metal Conduit (EIMC)

#### B. NECA References:

1. NECA 1 - Standard Practice of Good Workmanship in Electrical Construction
2. NECA 101 – Standard for Installing Steel Conduits (Rigid, IMC, EMT)
3. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).

#### C. NEMA References:

1. NEMA FB 1 – Fittings , Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
2. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
3. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
4. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
5. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing.
6. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

#### D. NFPA 70 - National Electrical Code.

#### E. UL References:

1. UL 1 - Flexible Metal Conduit
2. UL 6 – Electrical Rigid Metal Conduit – Steel.
3. UL 6A - Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
4. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations
5. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations
6. UL 360 - Liquid-Tight Flexible Metal Conduit.
7. UL 508 – Industrial Control Equipment.
8. UL 514A – Metallic Outlet Boxes.
9. UL 514B - Conduit, Tubing, and Cable Fittings.
10. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
11. UL 797 - Electrical Metallic Tubing – Steel.
12. UL 797A - Electrical Metallic Tubing – Aluminum and Stainless Steel.
13. UL 1242 - Electrical Intermediate Metal Conduit – Steel

### 1.04 DEFINITIONS

- A. Electrical Metallic Tubing (EMT): An unthreaded thinwall raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings.
- B. Electrical Nonmetallic Tubing (ENT): A nonmetallic, pliable, corrugated raceway of circular cross section with integral or associated couplings, connectors, and fittings for the installation of electrical conductors.



ENT is composed of a material that is resistant to moisture and chemical atmospheres and is flame retardant.

- C. Flexible Metal Conduit (FMC): A raceway of circular cross section made of helically wound, formed, interlocked metal strip.
- D. Intermediate Rigid Metal Conduit (IMC): A steel threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings. IMC materials include galvanized steel and stainless steel.
- E. Liquidtight Flexible Metal Conduit (LFMC): A raceway of circular cross section having an outer liquidtight, nonmetallic, sunlight-resistant jacket over an inner flexible metal core with associated couplings, connectors, and fittings for the installation of electric conductors.
- F. Pliable Raceway A pliable raceway is a raceway that can be bent by hand with a reasonable force but without other assistance.
- G. Rigid Metal Conduit (RMC): A threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings. RMC materials includes galvanized steel, stainless steel, red brass, and aluminum.
- H. Rigid Polyvinyl Chloride Conduit (PVC): A rigid nonmetallic raceway of circular cross section, with integral or associated couplings, connectors, and fittings for the installation of electrical conductors and cables.

#### **1.05 DESCRIPTION OF SYSTEM**

- A. Conduit sizes noted on Drawings are based on type THHN copper unless noted otherwise.
- B. Note that unless dimensioned conduit routing shown is diagrammatic only.
- C. See conduit application details and notes on Drawings for additional requirements.
- D. Conduit in soil:
  - 1. See also Section 26 0560.
  - 2. Use Schedule 40 or 80 PVC, tape wrapped IMC, PRMC, tape wrapped RMC.
  - 3. Transition from below grade to above grade: unless noted otherwise use IMC, PRMC, or tape wrapped RMC.
  - 4. Transition through basement or foundation wall: unless noted otherwise use PRMC, Schedule 80 PVC, tape wrapped IMC, or tape wrapped RMC conduit to at least 5 feet from wall.
- E. Conduit at exterior locations above grade:
  - 1. Use IMC, RMC, or PRMC.
  - 2. EMT with watertight fittings is acceptable.
  - 3. EMT conduit is not acceptable.
  - 4. Nonmetallic conduit is not acceptable.
- F. Conduit at slab on grade and slab below grade located within slab:
  - 1. Use Schedule 40 PVC, tape wrapped IMC, PRMC, or RMC.
  - 2. Where stub up occurs, tape wrapped IMC, PRMC, or RMC.
- G. Conduit in slab above grade:
  - 1. Maximum Size Conduit in Slab:  $\frac{3}{4}$  inch. Verify larger sizes with structural engineer.

2. Use RMC, IMC, EMT, or Schedule 40 PVC. Stubs shall be IMC, RMC, or EMT.
- H. Conduit at interior locations:
1. See also Section 26 0519 for acceptable uses of metal clad cables.
  2. Concealed within stud walls: Use EMT, or flexible steel conduit (FMC). Limit lengths of FMC concealed within walls to 6' or less.
  3. Concealed above accessible ceilings: Use EMT.
    - a. For connections to devices mounted within the accessible ceiling system or mounted to the ceiling tiles: use FMC in lengths no greater than 6' unless noted otherwise.
  4. Concealed above non-accessible ceilings: Use EMT.
  5. Exposed locations not subject to physical damage: Use IMC, RAC, RMC, EMT, and surface metal raceways (where approved or indicated).
  6. Exposed locations subject to physical damage use IMC or RMC.
  7. Subject to physical damage: Use IMC or RMC.
- I. Connections to vibrating equipment:
1. Use FMC or LFMC at dry locations.
  2. Liquidtight flexible metal conduit – used at wet and / or damp locations.
- J. Conduit exposed at kitchen dishwashing area:
1. Use stainless steel EMT (304 or 316), PVC coated RMC, or PVC coated IMC.
- K. Electric nonmetallic tubing (ENT) and flexible nonmetallic conduit are not acceptable except where specifically noted on drawings or other sections of the specification.

#### **1.06 REGULATORY REQUIREMENTS**

- A. Unless a larger size is indicated, size conduit to ANSI/NFPA70.

#### **1.07 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Conform to requirements of NFPA 70.
- C. Provide Products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and shown.

#### **1.08 SUBMITALS FOR REVIEW**

- A. Submit according to the requirements of Division 01 and Section 26 0000 – Electrical General Requirements.
- B. Provide manufacturer's catalog data for the following:
1. Floor boxes.
  2. Recessed backbox for monitor locations.
  3. Surface Raceway.
  4. Wireway.

## 1.09 SUBMITTALS FOR INFORMATION

- A. Submit according to the requirements of Division 01 and Section 26 0000 – Electrical General Requirements.
- B. See Section 26 0519 for requirements.

## 1.10 SUBMITTALS FOR CLOSEOUT

- A. Submit according to the requirements of Division 01 and Section 26 0100.
- B. As-Built Drawings:
  - 1. Where construction documents indicate locations, mounting heights, etc. to be verified, record actual modifications, final locations, and details.
  - 2. Indicate route of feeders.

## PART 2 PRODUCTS

### 2.01 CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but not limited to those listed herein.
- B. Minimum Size for conduit materials shall be 1/2 inch unless otherwise required, indicated or specified.
- C. See Section 26 0553 for conduit identification requirements.
- D. See Section 28 3113 and / or 28 3116 for fire alarm conduit identification.
- E. Flexible Metal Conduit (FMC):
  - 1. Manufacturers:
    - a. AFC Cable Systems, Inc.
    - b. Electriflex Co.
    - c. Or equal.
  - 2. Description: NFPA 70, type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1.
    - a. Interlocked steel construction.
    - b. If used as part of fire stop system FMC must be listed for applicable installation.
  - 3. Metallic Fittings and Conduit Bodies:
    - a. Manufacturers:
      - i) Bridgeport Fittings Inc.
      - ii) O-Z/Gedney
      - iii) Thomas & Betts Corporation.
    - b. Manufactured in accordance with ANSI/NEMA FB 1; listed and labeled as complying with UL 514B.
    - c. Material: Steel. Do not use cast zinc fittings.
- F. Liquidtight Flexible Metal Conduit (LFMC):
  - 1. Manufacturers:
    - a. AFC Cable Systems, Inc.

- b. Electriflex Co.
    - c. Or equal.
  - 2. Description: NFPA 70, LFMC PVC jacketed steel FMC listed and labeled as complying with UL 360.
    - a. Interlocked steel construction with PVC jacket.
  - 3. Metallic Fittings and Conduit Bodies:
    - a. Manufacturers:
      - i) Bridgeport Fittings Inc.
      - ii) O-Z/Gedney
      - iii) Thomas & Betts Corporation.
    - b. Comply with ANSI/NEMA FB 1; listed and labeled as complying with UL 514B.
    - c. Material: Steel. Do not use cast zinc fittings.
    - d. Rain tight compression ring with Insulated throat.
- G. Electrical Metallic Tubing (EMT):
- 1. Manufacturers:
    - a. Allied Tube and Conduit
    - b. Republic Conduit.
    - c. Wheatland Tube Co.
    - d. Or equal.
  - 2. Description: NFPA 70, type EMT steel electrical metallic tubing manufactured in accordance with ANSI C80.3 listed; labeled as complying with UL 797.
  - 3. Metallic Fittings and Conduit Bodies:
    - a. Manufacturers:
      - i) Bridgeport Fittings Inc.
      - ii) O-Z/Gedney
      - iii) Thomas & Betts Corporation.
    - b. Manufactured in accordance with ANSI/NEMA FB 1; listed and labeled as complying with UL 514B.
    - c. Material: Steel. Do not use cast zinc fittings.
    - d. Use set-screw or compression connectors and couplings. Do not use indenter type.
    - e. Where permitted for use in wet or damp locations use fittings listed for use in wet locations.
    - f. Embedded with Concrete: use "concrete tight" listed fittings.
- H. Rigid Polyvinyl Chloride (PVC) conduit:
- 1. Manufacturers:
    - a. Cantex.
    - b. Carlon.
    - c. Or equal.
  - 2. Description: NFPA 70, type PVC rigid polyvinyl chloride conduit manufactured in accordance with NEMA TC-2 listed and labeled as complying with UL 651.
    - a. Schedule 80 where subject to physical damage.
    - b. Schedule 40 unless noted otherwise.
  - 3. Fittings and Conduit Bodies:
    - a. Comply with NEMA TC-3; listed and labeled as complying with UL 651.

I. Galvanized Steel Rigid Metal Conduit (RMC):

1. Manufacturers:

- a. Allied Tube and Conduit
- b. Republic Conduit.
- c. Wheatland Tube Co.
- d. Or equal.

2. Description: NFPA 70, type RMC galvanized steel rigid metal conduit, manufactured in accordance with ANSI C80.1; listed and labeled as complying with UL 6.

3. Metallic Fittings and Conduit Bodies:

a. Manufacturers:

- i) Bridgeport Fittings Inc.
- ii) O-Z/Gedney
- iii) Thomas & Betts Corporation.
- iv) Or equal.

b. Non-Hazardous Locations: manufactured in accordance with ANSI/NEMA FB 1; listed and labeled as complying with UL 514B.

c. Material: steel or malleable iron. Do not use cast zinc fittings.

d. Connectors and Couplings: threaded type only. Do not use compression or set screw type.

J. Galvanized Intermediate Rigid Metal Conduit (IMC):

1. Manufacturers:

- a. Allied Tube and Conduit
- b. Republic Conduit.
- c. Wheatland Tube Co.
- d. Or equal.

2. Description: NFPA 70, type RMC galvanized steel rigid metal conduit manufactured in accordance with ANSI C80.6; listed and labeled as complying with UL 1242.

3. Metallic Fittings and Conduit Bodies:

a. Manufacturers:

- i) Bridgeport Fittings Inc.
- ii) O-Z/Gedney
- iii) Thomas & Betts Corporation.
- iv) Or equal.

b. Non-Hazardous Locations: manufactured in accordance with ANSI/NEMA FB 1; listed and labeled as complying with UL 514B and UL 1242.

c. Material: steel or malleable iron. Do not use cast zinc fittings.

d. Connectors and Couplings: threaded type only. Do not use compression or set screw type.

K. Rigid Aluminum Conduit (RAC):

1. Manufacturers:

- a. Allied Tube and Conduit
- b. Republic Conduit.
- c. Wheatland Tube Co.
- d. Or equal.

2. Description: NFPA 70, type RAC rigid aluminum conduit manufactured in accordance ANSI C80.5; listed and labeled as complying with UL 6A. Manufactured of 6063 aluminum alloy in temper designation T-1.
  3. Metallic Fittings and Conduit Bodies:
    - a. Manufacturers:
      - i) Bridgeport Fittings Inc.
      - ii) O-Z/Gedney
      - iii) Thomas & Betts Corporation.
      - iv) Or equal.
    - b. Non-Hazardous Locations: manufactured in accordance with ANSI/NEMA FB 1; listed and labeled as complying with UL 6A.
    - c. Material: Aluminum. Do not use galvanized.
    - d. Connectors and Couplings: threaded type only. Do not use compression or set screw type
- L. PVC Coated Steel Rigid Metal Conduit (PRMC):
1. Manufacturers:
    - a. Robroy Industries Plasti-Bond.
    - b. Calbond.
    - c. Ocal.
    - d. Substitutions according to provisions of Division 01 and Section 26 0000.
  2. Description: steel RMC with PVC coating meeting the performance standards specified by ANSI C80.1, NEMA RN 1 and listed and labeled as complying with UL 6.
  3. PVC coating shall be 40 mil thick.
  4. The conduit shall be hot dip galvanized inside and out with cold galvanized or hot galvanized threads.
  5. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.
  6. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit
  7. Fittings and Conduit Bodies:
    - a. Manufactured in accordance ANSI/NEMA FB 1; iron and steel bodies and fittings with external PVC coating to match conduit.
    - b. FORM 8 fittings shall have an O-RING molded with the coating of their covers. The fittings shall pass a UL observed pressure and vacuum tests retaining 25 Inch of vacuum and 17 PSI of pressure for a period of 80 hours. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours shall be available. Form 8 Condulets shall be supplied with plastic encapsulated stainless steel cover screws.
    - c. Female threads on fittings or conduit couplings shall be protected by application of a urethane coating.
  8. A urethane coating shall be uniformly and consistently applied to the interior of conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.
  9. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).
  10. Female threads on fittings or conduit couplings shall be protected by application of a urethane coating:

- a. ASTM D1151 - 00(2006) Standard Practice for Effect of Moisture and Temperature on Adhesive Bonds.
  - b. ASTM D3359 - 09e2 Standard Test Methods for Measuring Adhesion by Tape Test.
  - c. ASTM D1308 - 02(2007) Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
  - d. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
11. Hangers and Supports
- a. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. U bolts will be supplied with plastic encapsulated nuts that cover the exposed portions of the threads.
  - b. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit.
12. Installer Tools: Utilize manufacturer suggested tools (sockets, wrenches, hickies, clamps, jaws, etc.)
13. Misc.: Utilize manufacturer suggested touch-up materials.
- M. PVC Coated Aluminum Rigid Metal Conduit (PRMC-AL):
- 1. Manufacturers:
    - a. Robroy Industries Plasti-Bond.
    - b. Or equal.
  - 2. Description: aluminum IMC manufactured in accordance with NEMA RN 1, listed and labeled as complying with UL 6A. PVC coating shall be 40 mil thick.
  - 3. Fittings and Conduit Bodies: manufactured in accordance ANSI/NEMA FB 1; iron and steel bodies and fittings with external PVC coating to match conduit.
  - 4. Installer Tools: Utilize manufacturer suggested tools (sockets, wrenches, hickies, clamps, jaws, etc.)
  - 5. Misc.: Utilize manufacturer suggested touch-up materials.
- N. Nonmetallic Tubing: manufactured in accordance NEMA TC 2. Thinwall Schedule 20 for concrete encasement. Fittings and Conduit Bodies: NEMA TC 3.
- O. Locknuts shall be corrosion resistant steel. Bushings may be plastic or insulated throat metal.

## 2.02 OUTLET BOXES

- A. Manufacturers
  - 1. Appelton Electric.
  - 2. Crouse-Hinds.
  - 3. O-Z/Gedney.
  - 4. Square D. Co.
  - 5. Thomas & Betts.
  - 6. Wiremold Co.
  - 7. Raco Co.
- B. Sheet Metal Outlet Boxes: manufactured in accordance with NEMA OS 1; listed and labeled as complying with UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

- D. 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; include ½ inch male fixture studs where required.
- E. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb. Listed and labeled and marked for intended location and application.
- F. Gangable boxes are prohibited, unless specifically noted otherwise.
- G. Nonmetallic Outlet Boxes: manufactured in accordance with NEMA OS 2; listed and label as complying with UL 514C.
- H. Nonmetallic Outlet Boxes: are not acceptable.
- I. Cast Boxes: NEMA FB 1, Type FD, and FS..
- J. Wall Plates for Finished Areas: As specified in Section – Wiring Devices.

### **2.03 AUDIO / VIDEO OR COMMUNICATION OUTLET BOXES (UP TO 2" KNOCKOUT)**

- A. Manufacturers
  - 1. Raco Co.
  - 2. Subject to complying with these specifications the following manufacturers shall be acceptable.
    - a. Thomas and Betts.
    - b. Wiremold Co.
    - c. Appelton Electric.
    - d. Crouse-Hinds.
- B. RACO 263
  - 1. 4-11/16" H x 7-3/4" W x 3-1/4" D
  - 2. Accepts standard 4" square device and flat covers or RACO 792, 793, 794 3-gang device covers. (2 or 3 gang opening)
  - 3. Built-in tabs for spanner bars.
  - 4. Includes 1/2" thru 2" knockouts.
    - a. Side: (6) 1/2-3/4 in., (2) 3/4-1 in., (2) 1 - 1-1/4 in., (2) 1-2 in.
    - b. Bottom: (2) 1/2-3/4 in., (2) 3/4-1 in., (2) 1 - 1-1/4 in.
  - 5. Accepts 981 voltage partition (UL Listed)
  - 6. Welded construction.
  - 7. Raised ground screw.
- C. RACO 260
  - 1. 4-11/16" H x 4-11/16" W x 3-1/4" D
  - 2. Accepts standard 4-11/16" square device and flat covers.
  - 3. Includes 1/2" thru 2" knockouts.
    - a. Side: (2) 1/2-3/4 in., (2) 3/4-1 in., (2) 1 - 1-1/4 in., ( 2) 1-2 in.
    - b. Bottom: (2) 1/2 in., (2) 3/4-1 in.
  - 4. Welded construction.
  - 5. Raised ground screw.

### **2.04 RECESSED BACKBOXES FOR MONITOR LOCATIONS**

- A. Manufacturer:



1. Chief Manufacturing.
  2. Substitutions subject to compliance with requirements from manufacturers other than those listed above may be included.
- B. Description: Recessed, metallic, electrical box, with knockouts and single gang box mounting knockouts:
1. Pre-wire version: Chief PAC526.
  2. Include cover kit: Chief PAC526CVRW-KIT.
- C. Dimensions: 14-1/4" W x 14-1/4" T x 3.4" deep. Installs between 16" on-center studs.
- D. UL listed.

## **2.05 PULL AND JUNCTION BOXES**

- A. Manufacturers
1. Appleton Electric
  2. Crouse Hinds Co.
  3. Hoffman Engineering Co.
  4. O-Z/Gedney Co.
  5. Quazite (hand holes).
  6. Raco
  7. Spring City Electrical Manufacturing Co.
  8. Steel City.
  9. Wiegmann
  10. B-Line
- B. Sheet Metal Boxes: ANSI/NEMA OS 1, galvanized steel.
- C. Hinged Enclosures: As specified in Section – Low Voltage Electrical Distribution Equipment.
- D. Surface Mounted Cast Metal Box: NEMA 250, Type to suit project requirements; flat-flanged, surface mounted junction box.

## **2.06 FLOOR BOXES**

- A. Recessed Activation Two or Four Compartment (Cast Iron)
1. Manufacturer:
    - a. Wiremold RFB4-CI-1(4 compartment), RFB2-CI-1 (2 compartment)
    - b. Hubbell.
    - c. Steel City.
    - d. Approved equal.
  2. Description:
    - a. Recessed cast iron box; concealed multi-service.
    - b. Four wiring compartments with 1" and 1¼" knockouts.
    - c. Devices concealed in box below floor.
    - d. Watertight, fully adjustable in concrete pour.
  3. Accessories provide as required:
    - a. Duplex receptacle bracket.
    - b. Duplex GFCI bracket.
    - c. Modular Telephone/Data bracket with four RJ openings.
    - d. Active adapter bracket: accepts two 2A size active adapters.

- e. Blank cover.
  - f. Barrier kit.
4. Devices:
- a. Quantities and type as indicated on Drawings.
  - b. Devices as specified in Section 26 2726 - Wiring Devices
5. Cover:
- a. Flanged with carpet/tile cutout.
  - b. Flanged without carpet/tile cutout.
  - c. Flanged with furniture feed cover (allows 1-1/4" and 2" connections.
  - d. Flangeless with carpet/tile cutout.
  - e. Flangeless without carpet/tile cutout.
  - f. Flangeless with furniture feed cover (allows 1-1/4" and 2" connections.
  - g. Finish to be selected by the Architect from standard finishes.
- B. Recessed Activation Two or Four Compartment (Steel)
1. Manufacturer:
- a. Wiremold RFB4-SS-1(4 compartment), RFB2-SS-1 (2 compartment)
  - b. Hubbell.
  - c. Steel City.
  - d. Approved equal.
2. Description:
- a. Recessed steel box; concealed multi-service.
  - b. Four wiring compartments with 3/4" and 1 1/4" knockouts.
  - c. Devices concealed in box below floor.
  - d. Watertight, fully adjustable in concrete pour.
3. Accessories:
- a. Duplex receptacle bracket.
  - b. Duplex GFCI bracket.
  - c. Modular Telephone/Data bracket with four RJ openings.
  - d. Active adapter bracket: accepts two 2A size active adapters.
  - e. Blank cover.
  - f. Barrier kit.
4. Devices:
- a. Quantities and type as indicated on Drawings.
  - b. Devices as specified in Section 26 2726 - Wiring Devices
5. Cover:
- a. Flanged with carpet/tile cutout.
  - b. Flanged without carpet/tile cutout.
  - c. Flanged with furniture feed cover (allows 1-1/4" and 2" connections.
  - d. Flangeless with carpet/tile cutout.
  - e. Flangeless without carpet/tile cutout.
  - f. Flangeless with furniture feed cover (allows 1-1/4" and 2" connections.
  - g. Finish to be selected by the Architect from standard finishes.

C. Flush Service Ganged (Cast Iron)

1. Manufacturer:

- a. Wiremold 880 series.
  - b. Hubbell B4233 series.
  - c. Steel City 642 series.
  - d. Low Electric 1101 series.
  - e. Approved equal.
2. Description:
    - a. Recessed cast iron box; multi-service.
    - b. 1" conduit hubs.
    - c. Devices recessed in box flush with floor.
    - d. Watertight, adjustable in concrete pour.
    - e. Quantity of gangs required for devices or as indicated on Drawings.
  3. Devices:
    - a. Quantities and type as indicated on Drawings.
    - b. Devices as specified in Section 26 2726 - Wiring Devices
  4. Cover:
    - a. Flanged with flip top device covers.
    - b. Flanged with furniture feed cover (allows 1-1/4" and 2" connections.
    - c. Flangeless with flip top device covers.
    - d. Flangeless with furniture feed cover (allows 1-1/4" and 2" connections.
    - e. Finish to be selected by the Architect from standard finishes.
- D. Flush Service Ganged (Steel)
1. Manufacturer:
    - a. Wiremold 880 series.
    - b. Hubbell B2433 series.
    - c. Steel City 742 series.
    - d. Low Electric 1101 series.
    - e. Approved equal.
  2. Description:
    - a. Recessed steel box; multi-service.
    - b. 1" conduit hubs.
    - c. Devices recessed in box flush with floor.
    - d. Adjustable in concrete pour.
    - e. Quantity of gangs as required for devices or as indicated on Drawings.
  3. Devices:
    - a. Quantities and type as indicated on Drawings.
    - b. Devices as specified in Section - Wiring Devices
  4. Cover:
    - a. Flanged with flip top device covers.
    - b. Flanged with furniture feed cover (allows 1-1/4" and 2" connections.
    - c. Flangeless with flip top device covers.
    - d. Flangeless with furniture feed cover (allows 1-1/4" and 2" connections.
    - e. Finish to be selected by the Architect from standard finishes.

## 2.07 SURFACE METAL RACEWAY

- A. Manufacturers
  - 1. Wiremold Co.
  - 2. Substitutions under provisions of Division 01 and Section – Electrical General Requirements.
- B. Description:
  - 1. The raceway shall be a steel one-piece design with a base and cover factory assembled for use in installing small amounts of cabling. Wiremold V500 or V700 series.
  - 2. The raceway shall be a steel two-piece design with a base and cover, low-profile, single or dual channel. Dual channel base shall be divided into two compartments of 1/3 and 2/3 the width of raceway base and snap-on cover. Wiremold V2400 series.
  - 3. The designer series raceway shall be a steel two-piece design with a base and dual cover. Base shall be dividable with a fixed barrier for up to 4 compartments. Raceway shall be available in widths of 3/4" to 10" and depths of 17/32" to 5". Wiremold DS4000 series.
  - 4. The designer series raceway shall be an aluminum two-piece design with a base and dual cover. Base shall be dividable with a fixed barrier for up to 4 compartments. Raceway shall be available in widths of 3/4" to 10" and depths of 17/32" to 5". Wiremold ALDS4000 series
- C. Fittings: A full complement of fittings must be available including but not limited to mounting clips and straps, couplings, flat, internal and external elbows, cover clips, tees, entrance fittings, conduit connectors and bushings. Painted to match raceway. They shall overlap the raceway to hide uneven cuts.
- D. Boxes: Device boxes shall be available for mounting standard devices and faceplates. A device box shall be available in single- and multiple-gang configurations, up to six-gang. Single-gang boxes shall allow for snap-on and fastener application. Round fixture and extension boxes shall be available. Painted to match raceway.
- E. Finish: Manufacturer's standard Ivory finish. Field paintable.

## 2.08 WIREWAY

- A. Manufacturers
  - 1. Square D Co.
  - 2. Wiremold Co.
  - 3. Anchor Electric.
  - 4. Substitutions under provisions of Division 01 and Section – Electrical General Requirements.
- B. Description: General purpose, Oiltight and dusttight, Raintight type wireway as required to suit project requirements.
- C. Knockouts: None.
- D. Size: 4 x 4 inch, 6 x 6 inch, 8 x 8 inch, 12 x 12 inch; length as indicated.
- E. Cover: Hinged cover.
- F. Connector: Slip-in.
- G. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- H. Finish: Rust inhibiting primer coating with gray enamel finish.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify locations of floor boxes and outlets in areas prior to rough-in.
- B. Verify field measurements against construction drawings and shop drawings. Verify routing and termination locations of Products prior to rough-in.
- C. Review construction documents and provide site investigation to verify:
  - 1. Construction types.
  - 2. Fire resistance rating of partitions and other elements.
  - 3. Roof conditions.

### **3.02 PREPARATION**

- A. Coordinate work under provisions of Division 01, Section – Electrical General Requirements.
- B. Note the following: Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Coordinate exact locations and mounting heights required.
- C. Coordinate the following in preparation to installation:
  - 1. Exact routing and lengths required where conduit destination is indicated and routing is not shown.
  - 2. Note that unless dimensioned conduit routing shown is diagrammatic only.
  - 3. Mounting heights of outlets mounted above counters, benches, backsplashes, casework, cabinetry, and equipment. **DO NOT SCALE LOCATIONS OF OUTLET BOXES FROM ELECTRICAL DRAWINGS.**
  - 4. Route and installation details of exposed conduit and mounted boxes with Architect prior to installation.
  - 5. Locations and sizes of required access doors with Division 08.
  - 6. Location with roofing installation. Roof penetrations and seals shall be acceptable to Architect.
- D. Pre-Installation meeting: Convene prior to commencing work of this section:
  - 1. Coordinate the following with Architect, and Owner:
    - a. Locations for outlet boxes notified on Drawings as to be verified with Architect or Owner.
    - b. Location of outlet boxes in typical rooms (for example offices, classrooms, exam rooms).
    - c. Locations for floor boxes.
    - d. Review location and route of exposed conduit runs.
  - 2. Coordinate the following other trades:
    - a. Where conduit destination is indicated and routing is not shown, determine exact routing required to avoid conflicts with structure, piping, ductwork, equipment, etc.
    - b. Note that unless dimensioned conduit routing shown is diagrammatic only.
    - c. Ensure that code required and specified working and clearances and equipment spaces are maintained.
    - d. Coordinate locations and sizes of pull boxes.
    - e. Coordinate wall construction to ensure required construction type is provided for installation of flush mounted boxes.
- E. Unless noted otherwise, coordinate installation of exposed conduit with painters to ensure that conduits are painted after installation.

### 3.03 INSTALLATION BOXES

- A. Boxes installed in this project shall be as specified above unless expressly noted otherwise on the Drawings. Some notes below that relate to boxes not permitted by the above specifications are intended to address possible exceptions noted on the drawings.
- B. Install boxes in accordance with NECA 1 and manufacturer's instructions.
- C. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400 and Section 26 0500.
- D. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements. Actual locations must be coordinate in field. DO NOT SCALE LOCATIONS FROM ELECTRICAL DRAWINGS.
- E. Locate boxes as follows:
  - 1. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purposes.
  - 2. Set wall mounted boxes at elevations to accommodate mounting heights as specified or indicated in drawings. Coordinate mounting heights and locations as specified herein prior to rough-in.
  - 3. Install electrical boxes to maintain headroom and present neat mechanical appearance.
  - 4. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
  - 5. At inaccessible ceiling areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire. See Section 08 3100 for access panels.
  - 6. Orient boxes to accommodate wiring devices oriented as specified or indicated on drawings.
  - 7. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
  - 8. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices with each other.
  - 9. Locate devices in similar rooms in the same relative locations.
  - 10. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. See detail on Drawings.
  - 11. Non-acoustic rated walls: Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation.
  - 12. Acoustic rated walls: Do not install flush mounting box back-to-back in walls; provide minimum 24 inches separation
  - 13. Fire resistant rated walls: Comply with requirements of IBC Chapter 7 section "Penetrations".
- F. Support boxes at stud walls with stamped steel bridges between metal studs for device mounting. CADDY RBS16 or equivalent.
- G. Support boxes at accessible ceilings with adjustable steel channel fasteners for hung ceiling outlet boxes.
  - 1. Do not fasten boxes to ceiling support wires.
- H. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- I. Flush mounted boxes:
  - 1. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
  - 2. Accurately position boxes to allow for surface finish thickness.
  - 3. Utilize "plaster rings" appropriate for finish thickness.
  - 4. Finish rough openings around boxes in materials such as concrete, masonry, gypsum board, etc. so that there are no gaps or open spaces exceeding 1/8" and / or are visible when plate is installed.
- J. Utilize the following box types where noted:

1. Use flush mounting outlet box in finished areas.
  2. Use stamped steel bridges to fasten flush mounting outlet box between studs.
  3. Use multiple gang box where more than one device is mounted together. Do not use sectional (gangable) box.
  4. Use gang box with plaster ring for single device outlets.
  5. Use cast outlet box in exterior locations exposed to the weather and wet locations.
  6. Where exposed boxes are acceptable, use surface mounted metal hinged enclosures as junction boxes at interior dry and damp locations.
  7. Use surface mounted metal enclosure to suit project requirements in other than dry and damp locations.
  8. Large Pull Boxes: See specification Section – Low Voltage Electrical Distribution for boxes larger than 385 cubic inches in volume or 12 inches in any dimension
- K. Adjusting:
1. Adjust boxes to be flush and level with finish material.
  2. Adjust flush-mounting outlets to make front flush with finished wall material.
- L. Install knockout closures in unused box openings.
- M. Provide blank covers on un-used boxes.
- N. Identify boxes in accordance with Section 26 0553.

### **3.04 INSTALLATION CONDUIT**

- A. Install rigid PVC conduit in accordance with NECA 111.
- B. Install RMC in accordance with NEMA 101.
- C. Install Conduit in accordance with NECA 1 and manufacturer's instructions.
1. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.
  2. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
  3. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints.
  4. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- D. Unless specifically noted otherwise, conceal conduit including but not limited to the following locations.
1. Exterior walls.
  2. Finished areas.
  3. Across roofs.
  4. On, or on top off parapet walls.
  5. Across floors.
- E. Unless noted otherwise, exposed conduit and tubing is acceptable in only the following locations or conditions:
1. Mechanical rooms.
  2. Electrical rooms.
  3. Communication rooms.
  4. At exposed structural ceilings when routing has been approved by Architect.
- F. Route conduit as follows:

1. In general do not run conduit in slab except where required by floor outlets etc.
  2. Route conduit in and under slab direct point-to-point.
  3. Route conduit in wall voids and ceiling spaces.
  4. Where exposed conduit is noted as acceptable, route exposed conduit parallel and perpendicular to walls, including above accessible ceilings.
  5. Do not cross conduits routed in concrete slabs.
  6. Route parallel conduits in concrete at least 3 diameters apart in slab. Provide 2" minimum concrete cover in slabs.
  7. Route conduit to maintain headroom and present neat appearance.
  8. Route conduit to maintain adequate clearances. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
  9. Provide drip loops on LFMC.
- G. Support conduit as follows:
1. See Section 26 0500 for hangers and supports.
  2. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
  3. Arrange supports to prevent misalignment during wiring installation.
  4. Group related conduits; support using conduit rack. Construct rack using steel channel.
  5. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
  6. Do not attach conduit to ceiling support wires. Do not allow conduit to lay on ceiling tiles.
- H. Make conduit connections as follows:
1. Use of three piece or split fittings on threaded conduits is permitted only when neither piece of conduit can be rotated.
  2. Where transitioning from one type of conduit to another use appropriate adaptor.
  3. Utilize connectors and / or bushings with insulated throats.
- I. Penetrations:
1. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Divisions 07 .
  2. See also specification Section 26 0500 part 3 paragraph "Floor Wall and Ceiling Penetrations."
  3. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
  4. Do not penetrate structural members.
  5. Provide link-seal where conduits penetrate foundation or basement wall (below grade). See 260500 for sleeves.
  6. Provide sealing fitting or duct seal at accessible location near where conduits pass between areas of significant temperature differential including at coolers and freezers, exterior walls, between conditioned and non-conditioned areas.
- J. Provide suitable pull string in each empty conduit.
- K. Ground and bond conduit under provisions of Section 26 0526 – Grounding and Bonding of Electrical Systems.
- L. Identify conduit according to requirements of Section 26 0553 – Identification for Electrical Systems.

### **3.05 INSTALLATION SURFACE METAL RACEWAY, WIREWAY, WALL DUCT**

- A. Install Products in accordance with manufacturer's instructions.



- B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Wireway Supports: Provide steel channel as specified in Section – Basic Electrical Materials and Methods.
- E. Close ends of wireway and unused conduit openings.
- F. Ground and bond raceway and wireway under provisions of Section – Grounding and Bonding of Electrical Systems.

### **3.06 FIELD QUALITY CONTROL**

- A. Perform work in accordance with NECA Standard of Installation.
- B. Protect Products from corrosion and entrance of debris. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

### **3.07 CLEANING**

- A. Clean products under provisions of Division 01 and Section – Basic Electrical Materials and Methods.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

### **END OF SECTION**



# **SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Nameplates, labels, wire and cable markers, conduit markers.
- B. Hazard Labels.

### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and other sections of Division 26, 27, and 28.
- B. See Section 26 0519 Low Voltage Electrical Conductors and Cables
- C. See Section 26 0533 Raceway and Boxes for Electrical Systems
- D. See Section 26 0560 Underground Work for Electrical Systems
- E. See Section 26 2000 Low Voltage Electrical Distribution Equipment
- F. See Section 26 0920 Lighting Control Devices and Systems
- G. See Section 26 2726 Wiring Devices
- H. See Section 26 3200 Packaged Engine Generator Systems
- I. See Section 26 3600 Enclosed Transfer Switches
- J. See Section 26 5100 Lighting Fixtures and Luminaires
- K. See Section 27 1000 Communication Structured Cabling Systems
- L. See Section 28 1200 Intrusion Detection System
- M. See Section 28 1300 Door Access Control System
- N. See Section 28 2300 Video Surveillance System
- O. See Section 28 3113 Fire Alarm and Detection System
- P. See Section 28 3116 Fire Alarm and Detection System Extensions

### **1.03 REFERENCES**

- A. Division 01 - Quality Control, Reference Standards: Requirements for references and standards.
- B. NFPA 70 - National Electrical Code.
- C. ANSI 13.1 Scheme for the Identification of Piping Systems.

### **1.04 REGULATORY REQUIREMENTS**

- A. Work shall comply with the requirements of NFPA 70 (NEC) and state and local electrical codes.

## 1.05 QUALITY ASSURANCE

- A. Products: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## PART 2 PRODUCTS

### 2.01 NAMEPLATES AND SELF ADHESIVE LABELS

- A. Nameplates: Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Minimum 0.125" thick.
  - 1. 1/8-inch letters for identifying individual equipment and loads.
  - 2. 1/4 letters for identifying grouped equipment and loads.
- B. Self Adhesive Labels: Pressure sensitive adhesive back, rated for harsh environment.
  - 1. 1/2" clear label with black standard block type text.
  - 2. 1/4" clear label with 1/8" black standard block type text.

### 2.02 WARNING SIGNS, TAGS, AND HAZARD LABELS

- A. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- B. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
  - 2. Phase Color-Coding of 208Y/120V: "PHASE A - BLACK, PHASE B RED, PHASE C BLUE, NEUTRAL WHITE, GROUND GREEN."
  - 3. Phase Color-Coding of 480Y/120V: "PHASE A - BROW, PHASE B ORANGE, PHASE C YELLOW, NEUTRAL GRAY, GROUND GREEN."
  - 4. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 5. More than 600V Warning: "DANGER – HIGH VOLTAGE – KEEP OUT."
  - 6. 480V Warning: "480 VOLTS."
- D. Arc Flash Warning Labels:
  - 1. Description: Provide manufacturer's recommended arc flash and shock hazard label. See drawings for label detail or provide manufacturer's recommended arc flash and shock hazard label that includes flash hazard boundary distance, minimum Arc Thermal Performance Exposure Value (APTV) or Breakopen Threshold Energy Rating of PPE in cal/cm<sup>2</sup>, nominal system voltage, and limited, restricted and prohibited approach distances. Labels shall include black "WARNING" lettering or symbols on a yellow background.
  - 2. Locations:
    - a. Each electrical metering center, transformer, switchboard, motor control center, distribution panelboard, branch circuit panelboard, separate motor controller, and disconnect switch enclosure. Where gear is wider than 60 inches, provide labels at each end and in between at 80" O.C. maximum.
    - b. Communication and control equipment enclosures unless rated at 50 volts or less.
    - c. Other locations directed by Engineer.

E. Approach Boundaries:

Type	50 to 750 Volts	751 to 15 kV
Limited:	42 Inches	60 Inches
Restricted:	12 Inches	26 Inches
Prohibited:	1 Inch	7 Inches

**2.03 WIRE MARKERS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent waterproof black ink marker recommended by tag manufacturer.

**2.04 UNDERGROUND WARNING TAPE**

- A. Description: 4-inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.
- B. Location: Along length of each underground conduit/circuit installed by trenching or plowing.

**2.05 MISCELLANEOUS**

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength: 50 lb, minimum.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

**2.06 OPERATOR INSTRUCTIONS**

- A. Operator instructions shall be prepared professionally, printed on scaled drawing sheets (unless noted otherwise, minimum scale 1/16" = 1'-0" for floor plans), shall be in color, laminated, and shall be dated.
- B. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Degrease and clean surfaces to receive nameplates.
- B. Review labeling conventions and identifications with Owner.

- C. Obtain final room names and numbers from Owner.

### 3.02 INSTALLATION

- A. Install nameplates and labels in accordance with manufacturer's instructions and as follows:
  - 1. Install nameplate parallel to equipment lines.
  - 2. Secure nameplate to equipment front using screws.
  - 3. Secure nameplate to inside surface of flush mounted panelboards
- B. Conductor Identification:
  - 1. Power-Circuit Conductor Identification: For primary and secondary conductors No. 4 AWG and larger in pull and junction boxes, panelboards, disconnects etc. use color-coding conductor tape, marker tape, or write-on tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
  - 2. Branch-Circuit Conductor Identification: Use marker tape or write-on tags in each junction or pull box. Identify each ungrounded conductor according to source and circuit number
- C. Markers at Bolted Electrical Connections: Provide marking at bolted connections indicating connections have been tightened and list torque value. Utilize permanent tags, wire markers, or adhesive labels installed at the front cover of the panelboard, disconnect, switchboard, etc. (for flush mounted devices install inside the front cover).
- D. Identify underground conduits using one underground warning tape per trench at 3 inches (75 mm) below finished grade.
- E. Identify conduit and boxes as follows:
  - 1. Accessible Raceways 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A: Identify with orange snap-around label or stenciled legend adjacent to each junction box, pull box, and electrical enclosure. Indicate type of system and circuits located within (i.e. Normal or Emergency, 208/120 volt or 480/277 volt, panel ID and circuit number).
  - 2. Use the following color code for junction box covers:
    - a. Fire Alarm – Red.
- F. Provide nameplates at the following pieces of equipment with the information noted:
  - 1. Panelboards, switchboards, motor control centers: indicate name, voltage, bus amps, main OCPD amps, feeder OCPD location (i.e. fed from), maximum available fault current, equipment ampere interrupting rating.
  - 2. Enclosed switches and circuit breakers: indicate name of equipment served and its location if not within site, voltage, bus amps, circuit trip setting or fuse size, circuit OCPD location (i.e. fed from).
  - 3. Enclosed Motor Controllers: indicate name of equipment served and its location if not within site, voltage, horsepower rating, circuit trip setting or fuse size, circuit OCPD location (i.e. fed from). Include this labeling on controllers furnished by others Divisions and wired by Division 26. Provide matching nameplate at equipment served.
  - 4. Transformers: indicate name, primary and secondary voltages, kVA rating, feeder OCPD (i.e. fed from), final tap settings.
  - 5. Communication systems and electronic safety and security systems panels: indicate branch circuit number.
  - 6. Other locations directed by Engineer.
- G. Self adhesive label at the following devices with the information indicated:
  - 1. Receptacles – circuit number
  - 2. Pilot lighted control switches – name of equipment controlled, and circuit number
  - 3. Relays and Contactors – name of equipment controlled, and circuit number

4. Exhaust fans – name, horsepower, voltage, circuit number and characteristics.
  5. Time Clocks – designation (i.e. Time Clock 1), description of loads controlled (i.e. parking lot lights via Contactor 1), circuit number powering time clock, indicate which if any devices time clock interfaces with (for example photo sensor).
  6. Photoelectric sensors - circuit number powering device, circuit numbers controlled by device, indicate which if any devices sensor interfaces with (for example time switch, or relay panel), and designation of load controlled.
  7. Communications outlet plates Format: See 271000.
  8. Control Panels: Designation (name), source of power (circuit number where applicable), circuit characteristics.
  9. Addressable fire alarm devices –such devices (e.g. smoke detectors, pull stations) provide visible address label on base.
- H. Label back of receptacle plates with panel and circuit number in indelible ink.
- I. Labeling, nameplates, directories, etc. shall not contain Contractor Advertising.
- J. Circuit labels shall include description of load location (e.g. room name or number).
- K. Wall Plates: Use engraved wall plates.
1. Switches engrave nameplates with identification coordinated with Owner.
  2. Receptacles engrave nameplates with panel name and circuit number.
- L. Wire Marker Locations: On each conductor at each pull box, junction box, outlet box, terminal cabinet for the following: (These markers must be easily viewable to assure ease of wire identification.)
1. Control Wiring
  2. Fire Alarm
  3. Access Control.
  4. Video Surveillance.
  5. See 271000 for structured cabling requirements.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs or metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following: Power transfer switches and controls with external control power connections.
  2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
  3. Panelboards rated 208Y/120V or 480Y/277V: Apply phase color-code identification label to door or cover of equipment.
  4. Equipment rated 480V: Unless otherwise indicated, apply to door or cover of equipment. Apply to inside door or cover of flush panelboards and similar equipment in finished space.

### 3.03 CONDUCTOR IDENTIFICATION

- A. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

<u>Voltage</u>	<u>Phase A</u>	<u>Phase B</u>	<u>Phase C</u>	<u>Neutral</u>	<u>Grounding &amp; Bonding</u>
208/120	Black	Red	Blue	White	Green
480/277	Brown	Orange	Yellow	Gray	Green

**END OF SECTION**



# **SECTION 26 0560 - UNDERGROUND WORK FOR ELECTRICAL SYSTEMS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Excavation, trenching, and backfilling for underground electrical work including:
  - 1. Manholes and vaults.
  - 2. Underground duct.
  - 3. Handholes.
  - 4. Ductbank.
  - 5. Boreable raceway.

### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and other sections of Division 26, 27, and 28.
- B. Division 03 - Concrete Formwork, Concrete Reinforcement, Cast-In-Place Concrete.
- C. Division 07 - Thermal and Moisture Protection.
- D. Section 26 0100 Electrical Systems Close Out Documentation.
- E. Section 26 0533 Raceway and Boxes for Electrical Systems.

### **1.03 REFERENCES**

- A. General References:
  - 1. ANSI/IEEE C2 - National Electrical Safety Code.
  - 2. ANSI/NFPA 70 - National Electrical Code.
- B. Underground Ducts:
  - 1. ANSI/ASTM A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.
  - 2. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.
  - 3. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  - 4. ASTM A48 - Gray Iron Castings.
  - 5. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.
  - 6. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
  - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
  - 8. NEMA TC 6 - PVC and ABS Plastic Utilities Duct for Underground Installation.
  - 9. NEMA TC 7 - Smooth-Wall Coilable Electrical Polyethylene Conduit
  - 10. NEMA TC 8 - Extra-Strength PVC Plastic Utilities Duct for Underground Installation.
  - 11. NEMA TC 9 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
  - 12. NEMA TC 10 - PVC and ABS Plastic Communications Duct and Fittings for Underground Installation.
  - 13. NEMA TC 14 - Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.
  - 14. UL 651 Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings

### **1.04 DEFINITIONS**

- A. The following definitions apply to excavation operations:

1. Excavation: Refers to hand digging, trenching, back hoeing or any other method of moving existing site material from one place to another or removing existing site material from the site.
2. Additional Excavation: Refers to excavation required to reach suitable bearing materials if unsuitable bearing materials are encountered at planned sub-grade elevation. Contract sum may be adjusted by an appropriate Contract Modification.
3. Subbase: Refers to compacted soil layer used in pavement systems between the sub-grade and the pavement base course material.
4. Sub-grade: Refers to the compacted soil immediately below the slab or pavement system.
5. Unauthorized Excavation: Consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction from the Engineer.
6. Subsurface Utilities: Refers to privately and publicly owned lines such as water, sewer, sprinkler, electric, telephone, data, cable TV, gas, heating fuel, vent, motor fuel, signal, alarm, communications and any other line, pipe, cable or wire.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Furnish products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

#### **SUBMITTALS FOR CLOSEOUT**

- C. Submit according to the requirements of Division 01 and Section 26 0100.
- D. As-Built Drawings: Record route, locations, and depths of underground electrical work.

### **PART 2 PRODUCTS**

#### **2.01 SOIL MATERIALS**

- A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
- B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.
- C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP free of clay, rock, or gravel larger than 2 inches in any dimension. Do not use debris, waste, frozen materials, vegetable or other deleterious matter.

#### **2.02 UNDERGROUND RACEWAY**

- A. Rigid Steel Conduit: As specified in Section – Raceways and Boxes for Electrical Systems.
- B. Power Circuit Plastic Raceway:
  1. Description: Comply with UL 651 and NEMA TC 2; Schedule 40 or 80 PVC as indicated. Schedule 40 typically, schedule 80 under pavement.
  2. Fittings and Conduit Bodies: NEMA TC 3.
- C. Communications Plastic Raceway: Plastic Communications Duct and Fittings: NEMA TC 10, Type EB or Power Circuit Plastic Raceway as described above. Smooth wall.
- D. Directionally Bored Plastic Raceway:

1. HDPE
2. Comply with UL 651 and NEMA TC-7, schedule 40 or 80 (as described under Power Circuit Plastic Raceway).
3. Standard colors.
4. Smooth wall.

### **2.03 CONCRETE**

- A. Concrete shall conform to Division 03 of this specification.

### **2.04 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING**

- A. General Requirements for Handholes and Boxes:
  1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer Composite Handholes and Boxes: Molded of polymer composite material, with covers of polymer composite.
  1. Manufacturer:
    - a. Armorcast Products Company.
    - b. Highline.
    - c. NewBasis.
    - d. Or equal.
  2. Standard: Comply with ANSI/SCTE 77.
  3. Color of Box and Cover: Gray.
  4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  7. Cover Legend: Molded lettering, "ELECTRIC" or other custom logos and text.
  8. Retain "Conduit Entrance Provisions" Subparagraph below if conduit enters enclosure through the side. Otherwise, entry is made through an open bottom or through side openings cut in the field, as specified in "Installation of Underground Handholes and Boxes" Article. Coordinate with Drawings.
  9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  10. Handholes 10 Inches Wide by 15 Inches Long up to 17 Inches Wide by 30 Inches Long.

### **2.05 ACCESSORIES**

- A. Underground Warning Tape: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that excavation, base material installation, and compaction is completed.
- B. Verify that field measurements are as shown on drawings.

- C. Subsurface utilities were investigated during the design of the Project. The locations of existing subsurface utilities are approximately indicated and have not been independently verified.
- D. In addition to his own investigations, the Contractor shall call marking services prior to digging for any underground work.

### **3.02 PREPEARTION**

- A. Prepare excavation in accordance with manhole manufacturer's instruction.
- B. Coordinate work with project conditions.
- C. Verify routing and termination locations of duct bank prior to excavation for rough-in.
- D. Verify locations of manholes prior to excavating for installation.
- E. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system.
- F. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete ductbank system.
- G. Install work in locations shown on drawings, unless prevented by Project conditions.
- H. Coordinate connection of interior electrical systems with exterior underground and overhead utilities. Comply with requirements of franchised service companies.
- I. Prepare drawings showing proposed rearrangement of work to meet Project conditions, including changes to work specified in other Divisions. Obtain permission of Engineer before proceeding.

### **3.03 EXCAVATION**

- A. Slope sides of excavations to comply with codes and ordinances. Shore and brace as required for stability of excavation.
- B. Shoring and Bracing:
  - 1. Establish requirements for trench shoring and bracing to comply with codes and ordinances. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
  - 2. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- C. Install sediment and erosion control measures in accordance with codes and ordinances.
- D. Dewatering:
  - 1. Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding project site and surrounding area.
  - 2. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
  - 3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.
- E. Material Storage:

1. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
  2. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
  3. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- F. Excavation for Underground Manholes, Vaults and Electrical Structures:
1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete form work, installation of services, other construction, and for inspection.
- G. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
- H. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- I. Trenching: Excavate trenches for electrical installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and minimum of 6 to 9 inches clearance on both sides of raceways and equipment.
  2. Excavate trenches to depth indicated or required.
  3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
- J. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceways and equipment. Provide a minimum of 6 inches of sand cushion between rock bearing surface and electrical installations.
- K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.
- L. Backfilling and Filling:
1. Place soil materials in layers to required sub-grade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
  2. Backfill excavations as promptly as work permits, but do not until completion of the following:
    - a. Inspection, testing, approval, and locations of underground utilities have been recorded.
    - b. Removal of concrete formwork.
    - c. Removal of shoring and bracing, and backfilling of voids.
    - d. Removal of trash and debris.
  3. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
  4. Materials
    - a. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
    - b. Under building slabs, use drainage fill materials.
    - c. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.

- d. For raceways less than 25 inches below surface of roadways, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
- e. Other areas, use excavated or borrowed materials.

M. Placement and Compaction:

1. Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
  2. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  3. Moisture Control: Where sub-grade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.
  4. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
  5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
    - a. Area Under Structures, Building Slabs and Steps, and Pavements: Compact top 12 inches of sub-grade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    - b. Area Under Walkways: Compact top 6 inches of sub-grade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
    - c. Other Areas: Compact top 6 inches of sub-grade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
- N. Subsidence: Where subsidence occurs at electrical installation excavations during the period 12 months after substantial completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas. Restoration work shall meet Project Engineers approval.

### 3.04 FIELD QUALITY CONTROL

- A. The Contractor shall determine the exact location of utilities before commencing work and agrees to be fully responsible for any damages which might occur do to failure to exactly locate any and underground utilities. If any uncharted or incorrectly chartered subsurface utilities are encountered, contact Utility owner immediately for instructions.
- B. Support and protect utilities indicated to remain (or not indicated to be removed) during excavation operations.
- C. Maintain and protect existing building services that transit the area affected by selective demolition.

- D. Protect structures, subsurface and surface utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- E. Remove existing subsurface utilities indicated to be removed.
- F. Use of explosives is not permitted.

**END OF SECTION**





## **SECTION 26 0813 - TESTING OF ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

- A. This section includes general requirements that pertain to all Performance Verification Testing and Acceptance Testing requirements listed in Division 26 specifications.
- B. See Part 3 paragraph titled "Field Quality Control" of individual specification sections of Division 26 for test methods, procedures, test values, etc. specific to the materials and labor specified in that section.
- C. This section includes required tests applicable to Division 26 work in general.

#### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26.
- B. Division 26 Specification Sections:
  - 1. 26 0100 Electrical Systems Close Out Documentation
  - 2. 26 0519 Low Voltage Electrical Power Conductors and Cables
  - 3. 26 0526 Grounding and Bonding for Electrical Systems
  - 4. 26 0920 Lighting Control Devices and Systems
  - 5. 26 2000 Low Voltage Electrical Distribution Equipment
  - 6. 26 2726 Wiring Devices
  - 7. 26 4300 Surge Protective Devices
  - 8. 26 5100 Lighting Fixtures and Luminaires

#### **1.03 DEFINITIONS**

- A. See Section 26 0000 for definition of performance verification testing and acceptance testing.

#### **1.04 REFERENCES**

- A. NFPA 70 – National Electrical Code.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- C. Occupational Safety and Health Act (OSHA).
- D. ANSI/NFPA 70E, Standard for Electrical Safety in the Workplace.
- E. Owner's Safety Practices.

#### **1.05 SCOPE OF WORK**

- A. Electrical Contractor shall demonstrate proper operation of all equipment installed under these specifications to the Architect / Engineer and Owner's representative.
  - 1. Architect and Engineer and Owner shall be allowed to observe field acceptance testing and / or performance verification testing.
  - 2. Work involved with testing shall be coordinated with the Architect and Engineer and Owner and other Subcontractors.

- B. At the time of final observation, be prepared to test and operate any system as required by Architect, Engineer, or Owner's representative.
- C. Perform specified Acceptance Testing after installation and wiring of equipment is complete and after performance verification testing is complete.
- D. Electrical Systems to be Tested include the following:
  - 1. Secondary Service Electrical System.
  - 2. Grounding and Bonding Systems.
  - 3. Distribution and Branch Circuit Panelboards.
  - 4. Distribution Switchboards.
  - 5. Lighting Fixtures, Control Devices, and Control Systems.
- E. Division of Responsibility for Performance Verification Testing:
  - 1. The Electrical Contractor shall provide performance verification testing.
  - 2. Required documentation shall be provided by the Electrical Contractor including contract documents, specifications, equipment submittal data (e.g. shop drawings).
  - 3. Required documentation.
  - 4. Notification to the Architect of test dates and times.

#### **1.06 QUALITY ASSURANCE**

- A. Provide testing in accordance with NETA Acceptance Testing Specifications section 3 with modifications.
- B. Testing Personnel: Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.

#### **1.07 SAFETY AND PRECAUTIONS**

- A. As noted in specification section – Basic Electrical Materials and Methods and utilize Safety and Precaution procedure identified in NETA Acceptance Testing Specifications Section 5.1.

#### **1.08 SUBMITTALS FOR INFORMATION**

- A. Submit according to the requirements of Division 01 and Section – Electrical General Requirements.
- B. Prior to substantial completion, provide written verifications of test results of various systems as required by inspecting authorities and by other sections of these specifications.
- C. Provide written verifications that tests have been performed and test results for the following:
  - 1. Grounding system tests.
  - 2. Testing performed on conductors at service and major switchboards required by 26 0519.
  - 3. Witnessed mechanical inspections required by 26 0519.
  - 4. Continuity, function, and motor testing specified herein.
  - 5. Testing performed for lighting control devices.
  - 6. Testing performed for lighting control system.

#### **1.09 SUBMITTALS FOR CLOSEOUT**

- A. Submit according to the requirements of Division 01 and Section 26 0100.
- B. Operation and Maintenance Manuals: All test reports and / or certificates shall be included with the O & M Manuals.

## **PART 2 - PRODUCTS**

### **2.01 TEST EQUIPMENT**

- A. Provide specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
- B. Specialized tools, test equipment and instruments shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances.
- C. Calibration:
  - 1. Test instruments shall be calibrated in accordance with NETA Acceptance Testing Specifications section 5.3.
  - 2. A testing laboratory must have calibrated test equipment within the previous twelve (12) months.
  - 3. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.
  - 4. The accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).
  - 5. Calibrating standard shall be of better accuracy than that of the instrument tested.
- D. Infrared Thermographic Scanner: Infrared scanning equipment shall be an AGA (or approved equal) thermovision set capable of viewing an entire bus or equipment assembly at one time and have a sensitivity of 0.2 degrees C with a liquid nitrogen reference.
- E. Insulation Resistance Tester: At a minimum insulation resistance testing shall be performed with a Biddle "Megger" or equal.
- F. Ground Resistance Tester: At a minimum insulation resistance testing shall be performed with a Biddle "Megger" or equal.

### **2.02 TEST REPORT**

- A. The test report shall include the following:
  - 1. Summary of project.
  - 2. Description of equipment tested including a description of the equipment's location.
  - 3. Description of tests.
  - 4. Test data.
  - 5. Analysis and recommendations.
  - 6. Description of modifications made to improve test results.
- B. Test Data shall include the following:
  - 1. Identification of the testing organization.
  - 2. Equipment identification.
  - 3. Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.
  - 4. Date of inspections, tests, maintenance, and/or calibrations.
  - 5. Identification of the testing technician.
  - 6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
  - 7. Indication of expected results when calibrations are to be performed.
  - 8. Indication of as-found and as-left results, as applicable.
  - 9. Sufficient spaces to allow all results and comments to be indicated.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Verify that field conditions are acceptable and are ready for testing.
- B. Verify a suitable and stable source of electrical power is available at test site.
- C. Verify that all equipment is installed and ready for testing.
- D. Do not test or operate equipment for any purpose until it has been fully installed and serviced in accordance with the manufacturer's instructions.
- E. Notify the Architect of equipment which is disclosed by test as unsatisfactory and replace equipment or wiring furnished under the Contract which is disclosed by tests as unsatisfactory.

### **3.02 EXECUTION**

- A. Perform tests noted herein and specified elsewhere in Division 26 specifications and as noted below.
- B. Perform the following performance verification tests to all electrical appliances, systems, and work.
  - 1. Continuity Tests:
    - a. Test control, alarm, and temperature control low voltage circuits to verify continuity of wiring and connections.
    - b. The entire installation shall be tested free from open and short circuits and improper grounds.
  - 2. Phasing Tests:
    - a. Perform tests and checks necessary to establish proper phase relationship of connected equipment.
    - b. Check connections to motor-driven equipment for proper motor rotation. Correct connections as required.
    - c. Disconnect, prior to checks, any device which could be damaged by application of voltage or incorrect phase sequence.
  - 3. System Function Tests:
    - a. Verify controls of system prior to start-up to assure proper performance.
    - b. Verify proper operation of pushbuttons, hand switches, pilot lights, and other control devices.
    - c. Verify control circuits and programs for proper sequence of operation and interlocking functions.
    - d. Verify proper operation of sensing devices and alarms.
  - 4. Test motors under load with ammeter readings taken for each phase and record rpm of motors at time. Test motors for correct direction of rotation. Run tests on all motors and verify proper overload devices have been installed. Test and record the following on motors and submit the specified number of copies to the Engineer for review:
    - a. Motor No., Location, HP rating.
    - b. Motor circuit protector setting and size.
    - c. Fuse size. Heater size.
    - d. Full load amperes.
    - e. Running amperes.
    - f. Rated voltage.
    - g. Terminal operating voltage.

### **3.03 DOCUMENTATION**

- A. Provide written certificate(s) and include a copy with the O&M manuals, indicating that the inspections and tests specified herein have been performed.
- B. Provide test reports as specified above in Part 2.

**END OF SECTION**



## **SECTION 26 0920 - LIGHTING CONTROL DEVICES AND SYSTEMS**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Control devices used to control lighting fixtures and general purpose loads including:
  - 1. Stand Alone Occupancy Sensors.
  - 2. Daylight Sensors.
  - 3. Emergency lighting control device.
  - 4. Mechanical Time Switches
  - 5. Programmable Time Switches.
  - 6. Timer.
  - 7. External Thermostat
  - 8. Wall dimmers.
  - 9. Lighting Contactors.
  - 10. Exterior Photoelectric Sensors.
  
- B. Control systems used to control lighting fixtures and general purpose loads including:
  - 1. Lighting Control Panel – Relay Type
  - 2. Lighting Control Panel – Electrically Operated Circuit Breaker Type.
  - 3. Distributed Digital Lighting Control System.

#### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and other sections of Division 26, 27, and 28.
- B. Division 07 (Section 07 8400) – Firestopping
- C. See Section 26 0100 Electrical Systems Close Out Documentation
- D. See Section 26 0500 Common Work Results for Electrical for hangars and supports
- E. See Section 26 0519 Low Voltage Electrical Conductors and Cables
- F. See Section 26 0526 Grounding and Bonding for Electrical Systems
- G. See Section 26 0553 Identification for Electrical Systems
- H. See Section 26 2726 Wiring Devices
- I. See Section 26 5100 for light fixtures and ballast requirements
- J. See Section 27 1000 Communications Structured Cabling Systems

#### **1.03 REFERENCES**

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA ICS 2 - Starters, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
- D. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.

- E. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
- F. NFPA 70 - National Electrical Code.
- G. UL 508 – Industrial Control Equipment.
- H. UL 916 – Energy Management Equipment.
- I. UL 924 – Emergency Lighting and Power Equipment.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Products: Listed and classified by Underwriters Laboratories, Inc as suitable for the purpose specified and indicated.
- C. Manufacturer Design Services for Sensors: Manufacturer shall provide design services to determine final device quantities and locations required to provide complete coverage for areas indicated as needing devices. See requirements for submittal drawings.

#### **1.05 EXTRA MATERIALS**

- A. The Electrical Contractor shall install the following materials as directed by the Architect during Construction. The cost for labor, materials, overhead, profit, taxes and other incidental charges shall be included in the base bid. If such items are not required the Owner shall have the right to take possession.
  - 1. Provide 10% (minimum of 1) of each type of automatic lighting control sensor (e.g. occupancy sensor, daylight sensor, wallbox timer).

#### **1.06 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 01 and Section – Electrical General Requirements.
- B. Identifiers matching those used on the Drawings shall be included on the submittals including catalog sheets, one-line diagrams, panel schedules, etc.
  - 1. Submittals that do not include identifiers matching those on the project documents will not be reviewed, and will be returned marked “Revise and Resubmit.”
  - 2. If products are required that are not specifically identified on the drawings or in the specifications. Assign a unique identifier to that piece of equipment and clearly indicate that the equipment is not identified on the drawings and include a description of the products use and function.
- C. Provide manufacturer’s installation instructions, catalog data, and wiring diagrams for:
  - 1. Indoor Occupancy Sensors.
  - 2. Daylight Sensors.
  - 3. Emergency lighting control device.
  - 4. Programmable Time Switches.
  - 5. Timer.
  - 6. Wall dimmers.
  - 7. Lighting Contactors.
  - 8. Exterior Photoelectric Sensors.
  - 9. Distributed digital lighting control system.
- D. Occupancy sensor submittal data (both stand alone and digital type) shall include detailed detection coverage patterns.



- E. Provide floorplan indicating location, model number, and installation orientation for occupancy sensors and daylight sensors.
- F. Provide floorplan indicating location and coverage pattern of occupancy sensors. Note that device locations indicated on Drawings are diagrammatic only and intended only to show which locations require detectors.
- G. Lighting Control System Shop Drawings
  - 1. Provide detailed system one-line diagram specific to this project indicating every device in the system.
  - 2. Provide detailed panel layouts with schedules specific to this project.
  - 3. Provide narrative description of system operation.
- H. Include document indicating what field services are to be provided (matching this specification) and detailing contact information, scheduling constraints, etc.
- I. Submit system manufacturer qualifications statement indicating that requirements listed herein have been met. Include list of similar installations with references for each installation (references may be design engineer, building Owner, or Electrical Contractor).

#### **1.07 SUBMITTALS FOR INFORMATION**

- A. Submit according to the requirements of Division 01 and Section 26 0000 – Electrical General Requirements.
- B. Provide the following for the lighting control system:
  - 1. Installation Guide: Provide instructions on how to install system components
  - 2. Manual: Provide System User’s Guide and Programmer’s Guide in electronic pdf format.
- C. Submit manufacturer’s representative field reports. Provide a detailed description of activities on site within 14 days of site visit.

#### **1.08 SUBMITTALS FOR CLOSEOUT**

- A. Submit per the requirements of Division 01 and Section 26 0100.
- B. As-Built Drawings: include as-built drawings showing final locations, and circuit arrangements of devices included in this section.
- C. Operation and Maintenance Manuals:
  - 1. Approved and edited copy of Submittals for Review shall be included in the Operation and Maintenance Manuals.
  - 2. Include copies of documentation required by part 3 of this specification with the Operation and Maintenance Manual.
  - 3. Provide System User’s Guide and Programmer’s Guide in electronic pdf format for the following equipment:
    - a. Lighting control panel.
    - b. Distributed digital lighting control system.
  - 4. Provide a digital copy of the final lighting control system programming on a CD or USB flash drive.
  - 5. Provide current licenses, and backup copies of the software for the Owner's records.
  - 6. Training Video: The contractor shall provide a complete training video for installation of software, basic operation of software, and common components of system.

## **PART 2 PRODUCTS**

### **2.01 STAND ALONE OCCUPANCY SENSORS**

- A. Provide sensors scheduled on Drawings and complying with the requirements herein.
- B. Line voltage sensors (sensors operating at 120-volts nominal):
  - 1. Output suitable to switch 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V.
  - 2. Provide dual relay units where needed.
- C. Sensors operating as less than 50-volts:
  - 1. Provide relay unit (power pack) compatible with 24-volt occupancy sensors.
- D. Operation:
  - 1. Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a minimum of 1 to 15 minute adjustable time delay for turning lights off.
  - 2. Where scheduled provide Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
  - 3. Manual / automatic selector switch.
  - 4. Dual-technology Type: Sensitivity adjustment is separate for each sensing technology. Combination of passive-infrared and ultrasonic or passive infrared and microphonic.
- E. Relay Unit (Power Pack): Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V. Provide dual relay units where scheduled or indicated.
- F. Mounting: as scheduled on drawings. Suitable for mounting to a standard outlet box.
- G. Time-Delay and Sensitivity Adjustments: Recessed and concealed.
- H. Provide LED indicator light, to show when motion is being detected during testing and normal operation of the sensor.
- I. Faceplate for Wall-Switch Type: Refer to wall plate material and color requirements for toggle switches, as specified in Section – Wiring Devices.

### **2.02 STAND ALONE DAYLIGHT SENSORS**

- A. Manufacturer:
  - 1. As scheduled on Drawings.
  - 2. Substitutions according to provisions of Section – Electrical General Requirements.
- B. Description:
  - 1. Switching type.
  - 2. Single zone.
  - 3. 24-volt.
  - 4. Range: 1-1400 footcandles
  - 5. Deadband adjustment range: 25%, 50%, 75%, 100% above on setpoint.
  - 6. Adjustable time delay from 3 to 30 minutes with a minimum of two steps in between.
  - 7. Integral digital photosensor, microcontroller, and digital display.
  - 8. Five year warranty.
- C. Provide relay unit (power pack) compatible with 24-volt occupancy sensors.

- D. Automatic or manual setpoint selection. ON and OFF setpoints. Capable of operating with an occupancy sensor to hold lights on when occupied.
- E. Relay Unit (Power Pack): Dry contacts rated for 20A ballast load at 120V and 277V, for 13A tungsten at 120V, and for 1 hp at 120V. Provide dual relay units where scheduled or indicated.

### **2.03 EMERGENCY LIGHTING CONTROL DEVICE**

- A. A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting corresponding with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
  - 1. 120/277 volts, 50/60 Hz., 20 amp ballast rating
  - 2. Push to test button
  - 3. Auxiliary contact for remote test or fire alarm system interface

### **2.04 MECHANICAL TIME SWITCHES**

- A. Manufacturers:
  - 1. Paragon 4000 Series
  - 2. Tork 7000 Series
  - 3. Substitutions according to provisions of Section – Electrical General Requirements.
- B. Type:
  - 1. Single Pole, single throw
  - 2. Single pole, double throw
  - 3. Double pole, single throw
- C. 24 hour mechanism
- D. Surface or flush mounted.
- E. 120 volt clock motor.
- F. Spring Wound carry-over
- G. 40 ampere contacts
- H. Skip-a-day feature

### **2.05 MECHANICAL TIME SWITCHES WITH PHOTOCCELL INPUT**

- A. Manufacturers:
  - 1. Paragon
  - 2. Tork T900 Series with 2101 photocell.
  - 3. Substitutions according to provisions of Section – Electrical General Requirements.
- B. Three single-pole, double-throw switches with on-off-auto selector.
- C. 24 hour spring wound reserve power.
- D. With photocell.
- E. Surface mounted.
- F. Skip-a-day feature.

G. 120 Volt.

## 2.06 PROGRAMMABLE TIME SWITCHES

A. Microprocessor based solid-state time switch with individual circuits, each programmable on a separate schedule for each day of the week. Program entries are (one for each output circuit) controlled by internal relays. The time switch has internal batteries to maintain memory capability during utility power failure. Each circuit has manual override capability and visual on/off indication.

B. Single Channel

1. Manufacturer:
  - a. Paragon EL71
  - b. Intermatic ET7000 Series
  - c. Substitutions according to provisions of Section – Electrical General Requirements.
2. Single channel microprocessor-based
3. Pushbutton programming w/LCD screen
4. Programmable - 7 day with one on-off
5. Surface mounted, NEMA 1 enclosure
6. 120 volt clock motor
7. 30 ampere contacts
8. Skip-a-day feature
9. Manual Override
10. Latitude adjustment with sunrise and sunset adjustment
11. Daylight savings time and leap year adjustment.
12. Lithium battery back-up to maintain program and time-of-day for a minimum of 275 hours.

C. Two Channel

1. Manufacturer:
  - a. Paragon EL72
  - b. Intermatic ET7000 Series
  - c. Substitutions according to provisions of Section – Electrical General Requirements.
2. Two independent channels, microprocessor-based
3. Programmable - 7 day with one on-off
4. Surface mounted, NEMA 1 enclosure
5. 120 volt clock motor
6. 30 ampere contacts
7. Skip-a-day feature
8. Manual Override
9. Latitude adjustment with sunrise and sunset adjustment
10. Daylight savings time adjustment.
11. Lithium battery back-up to maintain program and time-of-day for a minimum of 275 hours.

D. Four Channel

1. Manufacturer:
  - a. Paragon EC74
  - b. Substitutions according to provisions of Section – Electrical General Requirements.
2. Head-bolt heater control
3. 7 day, four channel, microprocessor based
4. 192 total on/off events per day

5. 120 volt
6. Nema 1 enclosure
7. 10A rated contacts
8. Lithium battery back-up to maintain program and time-of-day for a minimum of

## **2.07 WALL MOUNTED TIMER**

- A. Manufacturer:
  1. Watt Stopper (TS-400).
  2. Substitutions according to provisions of Section – Electrical General Requirements.
- B. Selectable automatic with manual override on and off.
- C. Provide adjustable time delay of 5 minutes to 12 hours.
- D. Standard switch mounting height
- E. Device to be mounted in standard electrical box mounting.
- F. 120 volt with 20 amp load switching capability.

## **2.08 WALL DIMMERS**

- A. Manufacturer
  1. As specified on the Drawings.
  2. Substitutions according to provisions of Section – Electrical General Requirements.
- B. General Requirements
  1. Utilize air gap off, activated when user selects "off" to disconnect the load from line supply.
  2. Provide air gap service switch accessible without removing faceplate.
  3. Operates at the rated capacity across the full ambient temperature range including modified capacities for ganged configurations which require removal of fins.
  4. Provide radio frequency interference suppression.
  5. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
  6. Dimmers: Provide full range, continuously variable control of light intensity.
- C. Description:
  1. Dimmer Control: Paddle switch for on/off operation with small, discrete, captive linear slide for dimmer adjustment.
  2. 3-Way Dimmers: Provides multi-location capability using standard 3-way and 4-way mechanical switches.
- D. Preset Dimmer; 0-10V control for 0-10V fluorescent ballasts/LED drivers (50 mA max control current); no power pack required to switch line voltage load (8 A, 120-277 V); adjustable high-end and low-end trim; does not have locator light.

## **2.09 OCCUPANCY SENSOR WITH INTEGRAL WALL DIMMER**

- A. Passive Infrared 0-10V Wall Dimmer Vacancy Sensor
  1. Manufacturer and Model as Scheduled on the Drawings.
    - a. Substitutions: According to Division 01 and Section 26 0000
  2. Operates only as a vacancy sensor (manual-on and automatic-off).

3. 0-10 V control for 0-10 V fluorescent ballasts/LED drivers (8 A load at 120-277 V, 50 mA max control current); coverage of 900 square feet with mounting height of 4 feet; 180 degree field of view; multi-location capability using companion standard 3-way or companion switch (up to nine companion switches may be connected).

## 2.10 LIGHTING CONTACTORS

### A. Manufacturers:

1. Allen Bradley.
2. Asco.
3. Cutler Hammer.
4. Siemens.
5. Square D.
6. Substitutions according to provisions of Section – Electrical General Requirements

### B. Lighting Contactors

1. Description: NEMA ICS 2, magnetic lighting contactor.
2. Configuration: Electrically held or Mechanically held, 2 or 3 wire control.
3. Coil operating voltage: 120 volts, 60 Hertz or as indicated.
4. Poles: As required to match circuit configuration and control function.
5. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
6. Enclosure: NEMA ICS 6, Type 1 or as required to meet conditions of installation.
7. Accessories:
  - a. Pushbutton: ON/OFF HDOT.
  - b. Selector Switch: ON/OFF/AUTOMATIC HDOT.
  - c. Indicating Light: RED high brightness LED.
  - d. Auxiliary Contacts: One field convertible.
  - e. Control Power Transformers: 120 volt secondary, 50 va minimum, in each enclosed contactor. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

## 2.11 EXTERIOR PHOTOELECTRIC SENSORS

### A. Compatible with Time Switch.

### B. Manufacturer:

1. Intermatic.
2. Substitutions according to provisions of Section – Electrical General Requirements.

### C. Provide dusk-til-dawn control.

### D. Dry contacts rated for:

1. 120 volt – 1000VA Ballast, 1800W tungsten.
2. 208 volt – 1700VA Ballast, 3100W tungsten.

### E. Control shall be a thermal design with built-in delay to ensure that the controlled lighting does not switch off due to ambient light or lightning striking the photocell.

### F. Photo control shall function over temperature range of -40°F (-40°C) to 158°F (70°C).

### G. High impact polycarbonate housing.

- H. Mounting: Twist lock, with base-and-stem mounting or stem-and-swivel mounting accessories as required.

## 2.12 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

### A. System Description & Operation:

1. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relays controllers with 0-10 volt control for ballasts (if applicable) and single relay application-specific plug load controllers.
2. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
3. Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
4. Digital Photosensors – Single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
5. Configuration Tools – Handheld remote for room configuration provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send and receive of room variables and store of occupancy sensor settings. Computer software also customizes room settings.
6. Digital Lighting Management (DLM) local network – Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
7. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

### B. Basis of design product: WattStopper Digital Lighting Management (DLM).

1. Approved substitutes:
  - a. Sensor Switch NLight
2. Substitutions according to requirements of Section 26 0000.
3. By using approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

### C. Digital Occupancy Sensors

1. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.
2. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
  - a. Digital calibration and pushbutton programming for the following variables:
    - i) Sensitivity – 0-100% in 10% increments
    - ii) Time delay – 1-30 minutes in 1 minute increments
    - iii) Test mode – Five second time delay
    - iv) Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    - v) Walk-through mode
    - vi) Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
  - b. One or two RJ-45 port(s) for connection to DLM local network.

- c. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
- d. Device Status LEDs including:
  - i) PIR Detection
  - ii) Ultrasonic detection
  - iii) Configuration mode
  - iv) Load binding
- e. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
- f. Manual override of controlled loads.
- g. Units shall not have any dip switches or potentiometers for field settings.
- h. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

#### D. Digital Wall Switches

1. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration; available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:
  - a. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
  - b. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
  - c. Red configuration LED on each switch that blinks to indicate data transmission.
  - d. Blue Load/Scene Status LED on each switch button with the following characteristics:
    - i) Bi-level LED
    - ii) Dim locator level indicates power to switch
    - iii) Bright status level indicates that load or scene is active
2. Two RJ-45 ports for connection to DLM local network.
3. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
4. The following switch attributes may be changed or selected using a wireless configuration tool:
  - a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
  - b. Individual button function may be configured to Toggle, On only or Off only.
  - c. Individual scenes may be locked to prevent unauthorized change.
  - d. Switch buttons may be bound to any load on a room controller and are not load type dependant; each button may be bound to multiple loads.

#### E. Room Controllers

1. Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
  - a. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
  - b. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.



- c. Device Status LEDs to indicate: Data transmission, device has power, status for each load, configuration status.
  - d. Quick installation features including: Standard junction box mounting, quick low voltage connections using standard RJ-45 patch cable.
  - e. Plenum rated.
  - f. Manual override and LED indication for each load.
  - g. Dual voltage (120/277 VAC, 60 Hz).
  - h. Zero cross circuitry for each load.
- 2. Room controllers shall be three relay configuration.
  - 3. RJ-45 DLM local network ports.

#### F. Digital Photosensors

- 1. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.
- 2. Digital photosensors include the following features:
  - a. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
  - b. Sensor light level range shall be from 1-10,000 footcandles (fc).
  - c. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
  - d. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling after they turn off.
  - e. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
  - f. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
  - g. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
  - h. Red configuration LED that blinks to indicate data transmission.
  - i. Blue status LED indicates test mode, override mode and load binding.
  - j. Recessed switch to turn controlled load(s) ON and OFF.
  - k. One RJ-45 port for connection to DLM local network.
  - l. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.
- 3. Open loop digital photosensors include the following additional features:
  - a. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
  - b. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.

- c. A proportional control algorithm for dimming daylight harvesting with a “Setpoint” to be maintained during operation.
- G. Room Network (DLM Local Network)
  - 1. The DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building. Digital room devices connect to the network using CAT 5e cables with RJ-45 connectors which provide both data and power to room devices. Features of the DLM local network include:
    - a. Plug n’ Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
    - b. Simple replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
    - c. Push n’ Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
    - d. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
- H. Configuration Tools
  - 1. A configuration tool facilitates optional customization of DLM local networks, and is used to set up open loop daylighting sensors. A wireless configuration tool features infrared communications, while PC software connects to each local network via a USB interface.
  - 2. Features and functionality of the wireless configuration tool shall include:
    - a. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
    - b. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
    - c. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
    - d. Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.
    - e. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting.
    - f. Adjust or fine-tune daylighting settings established during auto-commissioning and input light level data to complete commissioning of open loop daylighting controls.
- I. Five year manufacturer warranty

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- D. Verify installation environment to ensure equipment is installed in appropriate enclosures with appropriate protection.

### **3.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.

- B. Clean debris from outlet boxes.
- C. Coordinate locations of device boxes provided under Section – Basic Electrical Materials and Methods to obtain mounting heights specified and indicated on drawings.
- D. Obtain and review installation instructions for digital occupancy and daylight management system.

### **3.03 INSTALLATION**

- A. Install cabling in accordance with Section 26 0519.
- B. Install in accordance with NECA "Standard of Installation," and with manufacturer's instructions.
  - 1. Install devices plumb and level.
  - 2. Install switches with OFF position down.
  - 3. Do not gang switches with dimmers.
  - 4. Install dimmers as recommended by the manufacturer where shown on drawings.
  - 5. Connect all co-located dimmers to the same phase of the power distribution system.
  - 6. Connect wiring devices by wrapping conductor around screw terminal.
  - 7. Complete conductor connections per manufacture's recommendations.
  - 8. Connect wiring device grounding terminal to outlet box with bonding jumper or branch circuit equipment grounding conductor where such conductor is specified, required or indicated.
  - 9. Provide separate neutral conductor for each installed dimmer.
- C. Wall Plates:
  - 1. Use jumbo size plates for outlets installed in masonry walls.
  - 2. Install decorative plates on all devices in finished areas.
  - 3. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
  - 4. Provide device colors as specified in Section Wiring Devices.
- D. Each low voltage control wire shall be labeled with the circuit number at each switch, ballast, tenant meter or sensor. Use stranded #18 AWG or larger wire as indicated on the drawings. Remote controlled circuits shall be recorded on the directory card in each panelboard.
- E. Provide slave relays where sensors are used in multi-switching or multi-circuit applications
- F. Standard light switches, i.e. single pole, 3-Way, 4-Way, Pilot and Lighted Handle types are specified in Section – Wiring Devices.
- G. Provide labeling as specified in Section – Identification for Electrical Systems.

### **3.04 FIELD QUALITY CONTROL**

- A. Performance Verification Testing:
  - 1. General: Comply with applicable standards of the National Electrical Testing Association (NETA) including Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems" and the requirements of specification Section 26 0813 Testing of Electrical Systems.
  - 2. Visually and Mechanical Inspection:
    - a. Inspect each device for secure mounting and defects.
    - b. Compare contactor amperage ratings with overcurrent protective device.
    - c. Verify the unit is clean.
    - d. Verify appropriate lubrication on current carrying parts and on moving or sliding surfaces.
    - e. Verify mechanical operation.

- f. Operate each lighting control device with circuit energized and verify proper operation.
- 3. Test and calibrate each automatic sensor for proper operation over entire operating range. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
- 4. Distributed Digital Lighting Control System: Provide manufacturer's factory authorized representative to verify complete and full functionality of the system:
  - a. Test and calibrate each automatic sensor for proper operation over entire operating range.
  - b. Test operation of all remote-controlled loads.
  - c. Test operation of all application-specific controllers.
  - d. Test operation of all network connections.
  - e. Test operation of control software on Owner's computer.
  - f. Test operation of complete lighting control system including all time schedules and control sequences.
  - g. Manufacturer's field services shall verify sequence of operation in each room. Verify each component operates as described in the sequence of operation. If control sequence is not clear submit questions in writing as an RFI for formal response.
  - h. It is required that 100% of all sensors be tested for proper operation (check all daylight sensors over range of light levels), operate every button on every switch, verify proper operation of all time schedules. Operate every load (i.e. switch each load on and off, and dim each load from 0 to 100% light output).
  - i. Provide a testing / commissioning reports.
  - j. If control sequence is not clear submit questions in writing as an RFI for formal response.
- B. Adjustments and Calibrations
  - 1. Stand Alone Sensors: Provide a minimum of 8 return visits after substantial completion to make adjustments to the sensor operation.
  - 2. Network Lighting Control System: Within one year of substantial completion, provide a minimum of 4 return visits by the Manufacturer's factory authorized representative after performance verification testing, start-up, and Owner training.

### 3.05 START UP

- A. The contractor shall provide the Owner, Architect, and Electrical Engineer a minimum of ten (10) working days written notice of the system startup.
- B. Adjust time delays on sensors so that controlled area remains lighted for the following time periods unless noted otherwise:
  - 1. In toilet rooms, storage rooms, and other areas not normally occupied: 5 minutes after occupant leaves area.
  - 2. In offices, classrooms, receptions, kitchen, library and other areas normally occupied: 20 minutes after occupant leaves area.
  - 3. In hallways / corridors: 30 minutes.
- C. Adjust settings of daylight sensors according to manufacturer's requirements to provide the following lights levels unless noted otherwise:
  - 1. At classrooms, offices, and other work surfaces: 40-footcandles average.
  - 2. At lobby, reception, and similar areas: 20 footcandles average at 30" above finished floor.
  - 3. At hallways, entrances and similar areas: 10 footcandles average at the floor.
  - 4. If questions arise as to the appropriate setting submit question in writing as an RFI for formal response.
- D. Set time delay on wall box timers to the following levels unless noted otherwise:

1. For shower rooms: 30-minute delay, with 5-minute blink warning.
2. For storage rooms: 5 minute delay with 1 minute blink warning.
3. If questions arise as to the appropriate setting submit question in writing as an RFI for formal response.

### **3.06 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Provide training and demonstration for:
  1. Occupancy sensors, wall box timers, daylight sensors.
  2. Emergency Lighting Control Device.
  3. Time switches.
  4. Distributed Digital Lighting Control System.
- B. Training and Demonstration shall include:
  1. Demonstration of control devices for owner after installation is complete.
  2. Provide the Owner with a tour highlighting locations of all control devices.
  3. Demonstrate proper operation of all control devices and systems including setting, resetting, and adjusting control devices.
  4. System review of all system components and their function
  5. System review of all management software and its function
  6. Operator training to develop experience with control applications.
- C. The training sessions for each lighting control system:
  1. Shall be conducted by a manufacturer's qualified representative.
  2. Training sessions shall include instruction on the physical equipment and operation as well as the use of the software and mobile app for control and programming
  3. Shall include a minimum of 8 hours for on-site training. Training to be provided in two 4-hour sessions on separate days.
  4. Include a minimum of 16 hours for remote training via video conference. Training sessions to be scheduled at the request of the Owner.
- D. The training sessions for the stand-alone sensors shall be conducted by a qualified technician who is knowledgeable in all aspects of the sensors' functions. Provide a minimum of 4 hours for on-site training. Training to be provided in two sessions – one initial 3-hour session and one 1-hour session during the 60-day re-commissioning

### **3.07 DOCUMENTATION**

- A. Documentation of Owner Training: Provide certificate (include copy with O & M manuals) similar to the example attached.
- B. Include a test report complying with the requirements of specification Section 26 0813 Testing of Electrical Systems Indicate results of tests performed under provisions of part 3 paragraph field quality control. Indicate actions taken to improve outcomes.

### **END OF SECTION**



# SECTION 26 2000 - LOW VOLTAGE ELECTRICAL DISTRIBUTION EQUIPMENT

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

- A. This section includes electrical distribution equipment rated 600 Volts and less
  - 1. Dry type distribution transformers with primary and secondary voltages 600 Volts and less of the following types:
    - a. Energy efficient transformers to meet current DOE standards.
    - b. Transformers designed for non-linear loads.
    - c. Harmonic mitigating transformers.
    - d. Buck-and-boost transformers.
    - e. Shielded isolation transformers.
  - 2. Switchboards.
  - 3. Panelboards.
  - 4. Electrical Cabinets and Enclosures.
  - 5. Current Transformer / Transition Cabinets.
  - 6. Terminal Blocks.
  - 7. Enclosed Switches and Circuit Breakers.
  - 8. Enclosed Motor Controllers.
  - 9. Contactors.
  - 10. Emergency Shutdown Pushbuttons.
  - 11. Fuses
  - 12. Molded Case Circuit Breakers
- B. Instrumentation.
- C. Power System Studies.
- D. Show Power Connection Panels.
- E. Shore Power Panels.
- F. Convention wall power panels.

### 1.02 RELATED DOCUMENTS

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26, 27, and 28.
- B. Section 26 0100 Electrical Systems Close Out Documentation.
- C. Section 26 0500 Common Work Requirements for Electrical.
- D. Section 26 0519 Low Voltage Electrical Power Conductors and Cables.
- E. Section 26 0526 Grounding and Bonding for Electrical Systems.
- F. Section 26 0553 Identification for Electrical Systems.
- G. Section 26 3200 Packaged Engine Generator Set.
- H. Section 26 4300 Surge Protective Devices.

### 1.03 REFERENCES

- A. General:
  - 1. NFPA 70, National Electrical Code
  - 2. IEEE C2, National Electrical Safety Code.
  - 3. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).
  - 4. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 5. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems
- B. NETA ATS – InterNational Electrical Testing Association Acceptance Testing Specification 2007 version (new versions may be substituted).
- C. Provide transformers in accordance with the following standards, where applicable:
  - 1. Underwriter’s Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
  - 2. Underwriter’s Laboratory 506, Standard for Safety for Specialty Transformers
  - 3. NEMA ST 20, Dry Type Transformers for General Applications
  - 4. NEMA 250, Enclosures for Electrical Equipment (1000 V Max)
  - 5. 2005 Energy Act Public Law 109-58 August 8 2005. Comply with all Rules from Department of Energy.
    - a. 10 CFR 29.
    - b. 10 CFR 431.
  - 6. NEMA TP1 (Guide for determining energy efficiency for distribution transformers)
  - 7. NEMA TP2 (Standard test method for measuring the energy consumption of distribution transformers)
  - 8. NEMA TP3 (Standard for the labeling of distribution transformer)
  - 9. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
- D. Provide switchboards in accordance with the following standards, where applicable:
  - 1. UL 891 – Switchboards.
  - 2. NEMA PB 2 - Deadfront Distribution Switchboards.
  - 3. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- E. Provide panelboards in accordance with the following standards, where applicable:
  - 1. NEMA PB 1 - Panelboards.
  - 2. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
  - 3. UL 67 – Panelboards.
- F. Provide Enclosed Switches and Circuit Breakers in accordance with the following standards, where applicable:
  - 1. NEMA KS 1 - Enclosed Switches.
  - 2. UL 98 - Enclosed and Dead-Front Switches.
  - 3. ASME A17.1 Safety Code for Elevators and Escalators.
  - 4. NEMA AB 4-2009 Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
- G. Provide enclosed motor controllers in accordance with the following standards, where applicable:
  - 1. NEMA ICS 1.3 Preventive Maintenance of Industrial Control and Systems Equipment.



2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
  3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
  4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
  5. NEMA ICS 7 – Industrial Control and Systems Variable Speed Drives.
  6. NEMA ICS 7.1 – Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- H. Provide disconnect and overcurrent protective devices in accordance with the following standards where applicable:
1. NEMA AB 1 - Molded Case Circuit Breakers.
  2. NEMA AB 4 - Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
  3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- I. Provide fuses in accordance with the following standards, where applicable:
1. NEMA FU1 - Low Voltage Cartridge Fuses.
- J. Provide instrumentation equipment in accordance with the following requirements, where applicable:
1. ANSI/IEEE C12 - Code for Electricity Metering.
  2. ANSI C39.1 - Electrical Indicating Instruments.
  3. ANSI C57.13 - Instrument Transformers.
  4. NEMA ICS 1.3 - Preventive Maintenance of Industrial Control and Systems Equipment.
  5. NEMA EI 21.1 - Instrument Transformers for Revenue Metering (110 kV BIL and Less).
- K. Provide meter centers (fixed type) in accordance with the following standards, where applicable:
1. NEMA AB 1 - Molded Case Circuit Breakers
  2. NEMA PB 1 – Panelboards
- L. Provide meter centers (bypass type) in accordance with the following standards, where applicable:
1. NEMA KS 1 - Enclosed Switches
  2. NEMA PB 2 - Deadfront Distribution Switchboards, File E8681
  3. NEMA PB 2 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
  4. NEMA PB 2.2 - Application Guide for Ground Fault Protective Devices for Equipment.
  5. UL 50 - Cabinets and Boxes.
  6. UL 98 - Enclosed and Dead Front Switches.
  7. UL 489 - Molded Case Circuit Breakers.
  8. UL 891- Dead-Front Switchboards.
  9. UL977 - Fused Power Circuit Devices.

#### **1.04 QUALITY ASSURANCE**

- A. Furnish products listed and classified by UL as suitable for purpose specified and shown.
- B. Installer: Trained in electrical safety per the requirements of NFPA 70E and OSHA.
- C. Switchboards:
  1. Comply with NEMA PB 2.
  2. Comply with UL 891.
- D. Panelboards:

1. Comply with NEMA PB 1.
2. Comply with UL 67.

#### **1.05 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 1 and Section – Electrical General Requirements.
- B. Provide the following submittal information for each item specified.
  1. Manufacturer’s product data sheets.
  2. Project specific shop drawings, mark drawings to indicate actual products provided.
- C. Circuit breakers: Provide manufacturer’s instruction manuals and catalog data for circuit breakers frame size 250-amp and larger. Mark submittal data to indicate actual products provided.
- D. Instrumentation: Provide manufacturer’s catalog data and shop drawings for meter and all associated CTs and PTs.
- E. Fuses: Provide manufacturer’s catalog data included
- F. Provide complete shop drawings for Show, Convention Wall, and Shore Power Connection Panels per the details on the drawings. Include product data for each component along with wiring schematics.

#### **1.06 SUBMITTALS FOR INFORMATION**

- A. Submit according to the requirements of Division 1 and Section – Electrical General Requirements.
- B. Circuit breakers: Provide manufacturer’s instruction manuals and catalog data for all programmable and / or adjustable circuit breakers. Mark submittal data to indicate actual products provided.
- C. Provide meter instruction manual (electronic version is acceptable). Mark submittal data to indicate actual products provided (model number and all options shall be indicated).
- D. Coordination Drawings: Submit coordination drawings for all electrical rooms.

#### **1.07 SUBMITTALS FOR CLOSEOUT**

- A. Submit according to the requirements of Division 01 and Section 26 0100.
- B. Operation and Maintenance Manuals include information specified in specification section Operation and Maintenance of Electrical Systems and documentation specified in Part 3. Include a copy of:
  1. Include a copy of Manufacturer’s routine maintenance requirements for switchboards, transformers, panelboards, circuit breakers, enclosed switches and circuit breakers, contactors, and enclosed motor controller.
  2. NEMA PB1.1 (Panelboards)
  3. NEMA PB2.1 (Switchboards)
  4. NEMA AB 4 (circuit breakers)
  5. NEMA ICS 1.3 (controllers).
  6. Provide final power system studies.
- C. As-Built Drawings: record locations of equipment, provide updated equipment schedules.

## **PART 2 PRODUCTS**

### **2.01 TRANSFORMERS**

- A. Manufacturers:

1. Siemens
2. Square D
3. Cutler Hammer
4. General Electric

B. General Requirements:

1. Sound levels shall be in conformance with NEMA ST20 unless specified otherwise.
2. Basic Impulse Level: 10 KV for transformers less than 300 KVA, 30 KV for transformers 300 KVA and larger
3. Core and Coil:
  - a. Cores shall be constructed with low hysteresis and eddy current losses and magnetic flux densities shall be kept well below the saturation point.
  - b. The core and coil assembly shall be installed on vibration dampening mounts and securely bolted to the enclosure. There shall be no metal to metal contact between the core and coil assembly and the enclosure except for a flexible grounding conductor.
  - c. The core and coil assembly shall be grounded to the enclosure by a flexible grounding conductor sized in accordance with UL and NEC standards.
  - d. Windings (coil) shall be wound of high quality aluminum or copper.
4. Sound Levels shall be warranted by the manufacturer no to exceed the following unless noted otherwise (review schedule on Drawings for modifications to these levels)
  - a. 15 to 50KVA - 45dB
  - b. 51 to 150kVA - 50dB
  - c. 151 to 300kVA - 55dB
  - d. 301 to 500kVA - 60dB
  - e. 501 to 700kVA - 62dB
  - f. 701 to 1000kVA - 64dB
  - g. 1001 to 1500kVA - 65dB
  - h. 1501 to 2000kVA- 66dB
5. Enclosure:
  - a. Ventilated
  - b. NEMA 1 or NEMA 3R as indicated.
  - c. Constructed of heavy gauge steel.
  - d. Enclosure wiring space and positioning of terminals shall allow adequate cable bending space.
  - e. The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed, and finished with ANSI#49 or ANSI #61 light grey baked enamel prior to assembly.
  - f. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
  - g. Standard indoor paint finishes are not acceptable for transformers installed out of doors. Outdoor transformers shall have at least two (2) coats of outdoor pad transformer quality baked enamel applied to rust inhibiting primer which has been applied to fully degreased metal parts. Paint shall be applied to all parts and fully dried before assembly. Painting after final assembly is not acceptable except as needed for touch up purposes.
6. Transformer(s) shall be rated as indicated on Drawings.

C. Energy Efficient Transformers

1. Description: Comply with NEMA ST 20, factory assembled, air cooled, dry type transformer 15 kVA through 750 kVA, 600V and less. Delta-connected primary and wye-connected secondary or as indicated otherwise.
2. Insulation system: UL recognized 220 degrees C with 150 degrees C rise above 40 degrees C ambient.

3. Winding Taps: Transformers 25 kVA and larger shall have a minimum of four (4) 2.5% full capacity primary taps.
4. Efficiency: Core and coil designs shall be low loss type with minimum efficiency ratings per DOE 10 CFR 431.192 April 2013. Efficiency shall be tested in accordance with NEMA TP-2, and transformer shall be labeled in accordance with NEMA TP-3.

## 2.02 PANELBOARDS

### A. Manufacturers:

1. Cutler-Hammer.
2. Siemens.
3. Square D.
4. General Electric

### B. General requirements:

1. Provide "suitable for service entrance equipment" label where applicable.
2. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
3. Panelboard Short Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

### C. Enclosures: Flush and surface-mounted cabinets

1. Type: NEMA 250 Type as indicated or required to suit project conditions at installed location:
  - a. Indoor Dry and Clean Locations: Type 1.
  - b. Outdoor Locations: Type 3R.
  - c. Kitchen and Wash-Down Locations: Type 4X, stainless steel.
  - d. Other Wet or Damp Locations: Type 4.
  - e. Indoor locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 5.
2. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat
3. Provide metal frame with transparent protective cover for directory card.

### D. Buses and Lugs:

1. Copper or Aluminum.
2. Equipment Ground Bus: Adequate for branch circuit equipment grounding conductors. Bonded to enclosure back box.
3. Isolated Ground Bus: Adequate for branch circuit isolated ground conductors. Insulated from back box. Provide where indicated on drawings.
4. Extra Capacity Neutral Bus and Lugs: Rated 200 percent of phase bus and UL listed as suitable for nonlinear loads. Provide where indicated on drawings.
5. Feed-Through Lugs: Locate at opposite end of bus from incoming lugs or main device. Provide where indicated on Drawings.
6. Main and Neutral Lugs: Compression type suitable for use with conductor material

### E. Branch Circuit Panelboards:

1. Construction:
  - a. Doors: Secured with vault type latch and tumbler lock, keyed alike.
  - b. Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover utilizing a continuous piano hinge on one side of the door.
  - c. Cabinet box: 6 inches deep; width: 20 inches wide, height as required.
2. Mains: Circuit breaker or Lugs only as indicated on Drawings.

3. Branch devices: Bolt on circuit breakers as indicated on Drawings.
- F. Distribution Panelboards:
1. Construction:
    - a. Doors: Secured with vault type latch and tumbler lock, keyed alike.
    - b. Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
    - c. Cabinet box: 6 inches deep; width: 20 inches wide, height as required.
  2. Mains: Circuit breaker or Lugs only as indicated on Drawings.
  3. Branch devices: Bolt on circuit breakers as indicated on Drawings.

## **2.03 ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

- A. Manufacturers:
1. Cutler Hammer.
  2. Siemens.
  3. Square D.
  4. General Electric.
- B. Enclosed Switches:
1. General: NEMA KS 1, UL 98, 600V ac, horsepower rated. Where indicated provide with clips to accommodate fuses specified.
  2. Heavy duty type load interrupter knife switch with externally operable handle interlocked with the cover to prevent opening with switch closed. Handle lockable in the off position. Mechanical type lugs, suitable for number, size, and conductor material.
  3. Accessories:
    - a. Equipment grounding kit internally mounted and labeled for copper and aluminum ground conductors.
    - b. Neutral kit internally mounted , insulated, capable of being grounded and bonded, and labeled for copper and aluminum ground conductors.
    - c. Isolated ground kit internally mounted, insulated, capable of being grounded and bonded, and labeled for copper and aluminum ground conductors. Provide where indicated.
    - d. Class R fuse kit rejects other fuse types. Provide where indicated.
    - e. Provide service rated switches where indicated or required.
- C. Enclosed Circuit Breakers:
1. General: circuit breaker indicated as specified herein mounted with a NEMA 250 enclosure.
- D. Shunt Trip Switches:
1. Comply with ASME A17.1, UL 98.
  2. Switch Assemblies: NEMA KS 1, UL 98, ASME A17.1, 600V ac, single throw, three pole, horsepower rated, with 200-kA interrupting and short circuit current rating when fitted with Class J fuses.
    - a. Integral shut trip mechanism and Class J fuse block.
    - b. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
    - c. Handle lockable in OFF position.
    - d. Control Circuit: Integral control power transformer, with primary and secondary fuses, and sufficient capacity to operate shunt trip, connected pilot light, and indicating and control devices.
    - e. Accessories:
      - i) Oiltight keyed test switch.

- ii) Oiltight red ON pilot light.
  - iii) Isolated 100 percent rated neutral lug.
  - iv) Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  - v) Form C alarm contacts that change state when the switch is tripped.
  - vi) Three pole, double throw, fire safety and alarm relay, 120V ac coil voltage.
  - vii) Three pole, double throw, fire alarm voltage monitoring relay complying with NFPA 72.
- E. Enclosure: Type: NEMA 250 Type as indicated or required to suit project conditions at installed location:
- 1. Indoor Dry and Clean Locations: Type 1.
  - 2. Outdoor Locations: Type 3R.
  - 3. Kitchen and Wash-Down Locations: Type 4X, stainless steel.
  - 4. Other Wet or Damp Locations: Type 4.
  - 5. Indoor locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 5.
  - 6. Hazardous Areas: Type 7.
  - 7. Finish using manufacturer's standard enamel finish gray color.'

## 2.04 ENCLOSED MOTOR CONTROLLERS

### A. Manufacturers:

- 1. Allen Bradley.
- 2. Cutler Hammer.
- 3. Siemens.
- 4. Square D.
- 5. General Electric

### B. Fractional Horsepower Motor Controllers

- 1. Manual Motor Controller: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, NO NC auxiliary contact, and toggle operator Pushbutton Operator.
- 2. Fractional Horsepower Manual Controller: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.
- 3. Motor Starting Switch: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with red pilot light and toggle operator.
- 4. Enclosure NEMA ICS 6, type 1, 1 flush, or 3R, Type 4, 4X, 12 to suite project conditions.

### C. Magnetic Automatic Motor Controllers (FVNR)

- 1. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for AC induction squirrel-cage motors rated in horsepower. Combination type where starter and disconnect are co-located or where indicated.
- 2. Provide combination magnetic motor controller with non-fusible fusible switch disconnect in common enclosure. Switch shall have externally operated handle with positive ON/OFF identification. NEMA KS 1, enclosed knife switch with visible blades where indicated.
- 3. Coil operating voltage: 120 volts, 60 Hertz.
- 4. Overload Protection: Provide melting alloy type for all motors 3 hp and smaller. Provide solid state for all motors larger than 3 hp.
- 5. Solid State: Trip current rating will be established by selection of overload relay and shall be adjustable (3 to 1 current range). The overload shall be self-powered, provide phase loss and phase unbalance protection, have a permanent tamper guard, and be ambient insensitive. It will also be available in Trip Class 10 or 20 and have a mechanical test function. With auxiliary contact.

6. Melting Alloy: with one-piece thermal unit construction. Thermal units shall be interchangeable. Overload relay control circuit contact shall be replaceable. Thermal units shall be required for starter to operate.
7. Minimum size: NEMA 1.
8. Enclosure NEMA ICS 6, type 1, 1 flush, or 3R, to suite project conditions.
9. Options and Features
  - a. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact. Required for each motor starter/controller.
  - b. Cover Mounted Pilot Device Contacts: NEMA ICS 2, Form Z, rated A150.
  - c. Pushbuttons: Recessed or Unguarded or Shrouded or Shielded or Covered Lockable type, oiltight A-B 800H or equal.
  - d. Indicating Lights: NEMA ICS 2 Transformer 6V cluster LED type, heavy duty oiltight A-B 800H or equal. Red, Green, Amber, Clear.
  - e. Selector Switches: Rotary type, oiltight A-B 800H or equal. Hand-Off-Auto.
  - f. Relays: NEMA ICS 2.
  - g. Control Power Transformers: 120 volt secondary, 150 va minimum, in each motor starter. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure. One required for each motor starter/controller.

## 2.05 CONTACTORS

### A. Manufacturers:

1. Allen Bradley.
2. Asco.
3. Cutler Hammer.
4. Siemens.
5. Square D.
6. Substitutions according to provisions of Section – Electrical General Requirements

### B. General Purpose Contactors

1. Description: NEMA ICS 2, AC general purpose magnetic contactor.
2. Configuration: Electrically held or Mechanically held 2 or 3 wire control as indicated or scheduled.
3. Coil operating voltage: 120 volts, 60 Hertz or as indicated.
4. Poles: As required to match circuit configuration and control function.
5. Enclosure: NEMA ICS 6, Type 1 or as required to meet conditions of installation.
6. Accessories:
  - a. Pushbutton: ON/OFF, HDOT.
  - b. Selector Switch: ON/OFF/AUTOMATIC, HDOT.
  - c. Indicating Light: RED high brightness LED.
  - d. Auxiliary Contacts: One field convertible.
  - e. Control Power Transformers: 120 volt secondary, 50 va minimum, in each enclosed contactor. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

## 2.06 EMERGENCY SHUTDOWN PUSHBUTTONS

### A. Manufacturer

1. ABB
2. Square D
3. Siemens
4. Eaton
5. Allen Bradley

- 6. Pilla Electric
- B. Description: Large heavy duty mushroom operator, maintained contact, Keyed reset.
  - 1. When used at boilers, faceplate shall read "Emergency Boiler Shut-Down"
  - 2. Clear lift cover.
- C. Mounting:
  - 1. Surface
- D. Restricted access cover
- E. Contacts rated at 10-amperes, 600 Volts.

## **2.07 MOLDED CASE CIRCUIT BREAKERS**

- A. General Characteristics:
  - 1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle, and the accessory mounting area.
  - 2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which shall provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
  - 3. The circuit breaker handle shall reside in a tripped position between on and off to provide local trip indication. Circuit breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings.
  - 4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
  - 5. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
  - 6. Circuit breakers shall be factory-sealed with a hologram quality mark and shall have date code on face of circuit breaker.
  - 7. MCCB's shall be able to receive a device for locking in the isolated position.
  - 8. Electronic components shall withstand temperatures up to 221 °F (105 °C).
  - 9. Circuit breakers shall be UL-listed to accept field installable/removable mechanical type lugs (except Type QB/QD/QG/QJ). Lugs shall be UL-listed to accept solid and/or stranded copper and aluminum conductors. Lugs shall be suitable for 194 °F (90 °C) rated wire, sized according to the 167 °F (75 °C) temperature rating in the NEC.
  - 10. Circuit breakers shall be capable of accepting bus connections.
- B. Trip Unit General Requirements:
  - 1. MCCB's with ratings up to 400 amperes shall be equipped with thermal magnetic unless noted otherwise electronic trip units.
  - 2. MCCB's with ratings over 400 amperes shall be equipped with electronic trip units.
  - 3. Circuit breakers with permanent trip units shall be UL-listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
  - 4. The trip units shall not augment overall circuit breaker volume.
- C. Trip Unit Thermal Magnetic (400 Ampere Frame and Below):
  - 1. Basis of Design: "PowerPact Q-, H- and J-Frame", FA, LA, and LH as manufactured by Square D by Schneider Electric.
  - 2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 °F (40 °C) ambient temperature.



3. Circuit breaker frame sizes above 150 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker
  4. Where indicated on drawings, Circuit breakers shall be equipped with a ground fault module (GFM) with 20 ampere to 200 ampere sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equal.
- D. Trip Unit ET 1.0 Trip System (300 Amperes to 800 Amperes):
1. Basis of Design: "PowerPact M-Frame" (300 amperes to 800 amperes) as manufactured by Square D by Schneider Electric.
  2. The circuit breaker trip system shall be a microprocessor-based true RMS sensing design. Sensor ampere ratings shall be as indicated on the Drawings or schedules.
  3. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
  4. Trip unit shall not be field-replaced.
  5. ET 1.0 trip unit functions shall consist of adjustable instantaneous pickup with no intentional time delay.
  6. The long time trip point setting shall be fixed and cannot be adjusted.
  7. The instantaneous settings on the trip unit shall allow 2 to 10 times the sensor rating (In). The trip unit shall have the capability for the adjustment to be set and read locally by a rotating switch.
  8. Ground fault protection shall not be provided.
- E. Accessories: Provide the following accessories where noted, specified, or indicated.
1. General:
    - a. Circuit breakers shall be equipped with UL-listed electrical accessories as noted on the Drawings or schedules or they may be field-installable.
    - b. The addition of auxiliaries shall not increase the volume of the circuit breaker.
    - c. The addition of a motor mechanism module or a rotary handle, etc., shall not mask or block device settings.
  2. Electrical Auxiliaries: Electrical auxiliaries, such as voltage releases (shunt and undervoltage releases) and indication switches as follows:
    - a. Same field-installable auxiliary contacts for signaling different functions, such as open/ closed position, fault signal, electrical fault (including electrical leakage) signal. Auxiliaries shall be common for the entire range,
    - b. Electrical auxiliaries shall be separated from power circuits,
    - c. Electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
    - d. Electrical auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself.
  3. Equipment Ground Fault Protection Modules (Thermal Magnetic Circuit Breakers):
    - a. Basis of Design: "PowerPact H- and J-Frame" as manufactured by Square D by Schneider Electric.
    - b. General:
      - i) Circuit breakers shall be equipped with a ground fault module (GFM) with 20 ampere to 200 ampere sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equal.
      - ii) Ground fault sensing system shall be modified zero sequence (GFM) or zero sequence (ELM) sensing type.
      - iii) The ground fault system shall require no external power to trip the circuit breaker.
      - iv) Companion circuit breaker shall be equipped with a ground fault shunt trip.
      - v) The ground fault sensing system shall be suitable for use on solidly grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits

where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems. ELM shall be suitable for use on three-phase, three-wire circuits only.

- vi) Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
  - vii) The ground fault sensing system shall include, but shall not be limited to, a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
  - viii) A means of testing the ground fault system to meet the on-site testing requirements of NEC Section 230-95(c) shall be provided.
  - ix) Local visual ground fault trip indication shall be provided.
  - x) The ground fault sensing system shall be provided with zone selective interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on the Drawings or schedules. ELM shall not be provided with ZSI capabilities.
  - xi) The companion circuit breaker shall be capable of being group mounted.
  - xii) The ground fault sensing system shall not affect interrupting rating of the companion circuit breaker.
4. Handle Accessories: Circuit breaker handle accessories shall provide provisions for locking handle in the on and off position.

## 2.08 FUSES

### A. Manufacturers:

- 1. Bussman.
- 2. Littlefuse.
- 3. Shawmut.
- 4. Substitutions under provisions of Division 01 and Section – Electrical General Requirements.

### B. General Requirements: NEMA FU 1, class as specified or indicated. Voltage rating suitable for circuit phase to phase voltage.

- 1. Main Service Switches Larger than 600 amperes: Class L (time delay).
- 2. Main Service Switches: Class RK1 (time delay).
- 3. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- 4. Power Load Feeder Switches: Class RK1 (time delay).
- 5. Motor Load Feeder Switches: Class RK1 (time delay).
- 6. Lighting Load Feeder Switches Larger than 600 amperes: Class L time delay.
- 7. Lighting Load Feeder Switches: Class RK1 (time delay).
- 8. Other Feeder Switches Larger than 600 amperes: Class L time delay.
- 9. Other Feeder Switches: Class RK1 (time delay).
- 10. General Purpose Branch Circuits: Class RK1 (time delay).
- 11. Motor Branch Circuits: Class RK1 (time delay).
- 12. Motor Starter Control Power Transformer: Class G.

## 2.09 HINGED COVER CABINETS AND ENCLOSURES

### A. Manufacturer:

- 1. Hoffman Engineering.
- 2. American Midwest Power.
- 3. Shallbetter Industries.
- 4. States Electric Co.

5. EMI Industries.
  6. Substitutions according to provisions of Section – Electrical General Requirements.
- B. Construction: NEMA 250, Type to suit project requirements and as shown on the drawings; steel enclosures; white enamel interior.
  - C. Covers: Continuous hinge, held closed by latch operable by key; white enamel interior.
  - D. Provide interior metal panel for mounting terminal blocks and electrical components; finished with white enamel.
  - E. Enclosure Exterior Finish: Manufacturer’s standard enamel.
  - F. See Section Raceway and Boxes for Electrical Systems for boxes of sizes smaller than 384 cubic inches or 12” any one dimension.
  - G. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power wiring.
  - H. Provide accessory feet and front closure panel for free standing equipment where indicated.
  - I. Hinged sub panels (approximately 1 inch below front) where indicated.

## **2.10 CURRENT TRANSFORMER/TRANSITION CABINET**

- A. Manufacturers:
  1. American Midwest Power.
  2. Electro-Mechanical Industries. (EMI)
  3. Substitutions according to provisions of Section – Electrical General Requirements.
- B. Pad mounted:
  1. NEMA 3R construction with front and back doors. Doors shall be double opening with 3 point vault type latch and pad lock hasp. Provide hold open devices. Roof shall be formed steel to provide sloped drainage surfaces.
  2. Construction shall be welded with ground smooth joints and covers.
  3. Prime coat and finish pint all inside and outside surfaces after cleaning and degreasing.
  4. Provide concrete pad as directed or as required by conditions. Note that pad may be common with transformer.
- C. Wall mounted:
  1. NEMA 3R construction, sheet metal cabinet with hinged door, conforming to Utility Company requirements, with provisions for locking and sealing.
  2. Size: As required by Utility. As shown on Drawings.
- D. Bus bars shall include provisions for Utility Company (See Basic Elec Materials & Methods) or Owner current transformers (as indicated on drawings).
- E. Bars shall be copper or aluminum, voltage and current shall be as indicated on drawings. Provide full bus capacity lugs for each phase and neutral.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Receive, inspect, handle and store equipment in accordance with manufacturer’s instructions and NECA.

- B. Examine equipment before installation and reject equipment that is damaged, rusted or have been subjected to water saturation.
- C. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each piece of equipment.
- D. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where equipment will be installed.
- E. Examine utilization equipment nameplates and installation instructions. Install fuses or circuit breakers of sizes and with characteristics appropriate for each piece of equipment.
- F. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performances, such as rejection features.

### **3.02 PREPARATION**

- A. Interruption of Electric Service: According to provisions of Section – Basic Electrical Materials and Methods paragraph “Interruptions and Outages.” Comply with NFPA 70E.
- B. Provide 3-1/2” high concrete housekeeping pads under floor mounted equipment. Pad shall extend ½” outside enclosure minimum. Coordinate size and location of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- C. Coordinate installation of wall-mounting and structure-hanging supports with requirements for each individual piece of equipment provided.
- D. Coordinate layout and installation of equipment with other construction, including electrical and other types of equipment (raceways, piping, air ducts, etc.) to maintain working clearances required by NFPA 70 and manufacturer's written instructions. Drawings indicate maximum dimensions for equipment including clearances between adjacent surfaces and other items. Comply with maximum dimensions indicated on Drawings. Verify that dimensions indicated on Drawings and shop drawings are compatible with field measurements.
- E. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- F. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load

### **3.03 INSTALLATION**

- A. Install Products in accordance with manufacturer's instructions, referenced NEMA standards, in accordance with NECA Standard of Installation.
- B. Set equipment plumb and level. Provide rigid supports and do not distort enclosures.
- C. Transformers:
  1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
  2. Trapeze hung transformers use hangers and supports under provisions of Section – Basic Electrical Materials and Methods.
  3. Use flexible conduit, 2 ft minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

- D. Panelboards:
1. Provide filler plates for unused spaces in panelboards.
  2. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling or below floor. Minimum spare conduits: 4 empty 3/4 inch. Identify each as SPARE.
  3. Ground and bond panelboard enclosure according to Section - Grounding and Bonding for Electrical Systems.
  4. Provide and install plywood panels for mounting panelboards and/or loadcenters in accordance with Section – Basic Electrical Materials and Methods. Mount plywood sheets 2'-0" above finish floor, horizontally, so top of plywood is 6'-0" above finish floor. Prime and paint with two coats of durable fire retardant gray enamel on all surfaces prior to mounting panelboard and/or loadcenter.
- E. Fuses: Install fuse with label oriented such that manufacturer, type, and size are easily read.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- G. Identification:
1. Provide identification in accordance with specification section Identification for Electrical Systems and NFPA 70.
  2. Identify field installed conductors, interconnecting wiring, and components.
  3. Provide warning signs and hazard labels.
  4. Provide typed circuit directory for each branch circuit panelboard.
  5. Directories shall not contain Contractor Advertising.
  6. Circuit labels shall include description of load location and load type (e.g. room name or number – receptacles or lighting).
  7. Markers at Bolted Electrical Connections: Provide marking at bolted connections indicating connections have been tightened and list torque value. Utilize permanent tags, wire markers, or adhesive labels installed at the front cover of the panelboard, disconnect, switchboard, etc. (for flush mounted devices install inside the front cover).
  8. At service entrance equipment provide indication of maximum available fault current as required in NFPA 70.
- H. Cleaning: On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

### **3.04 FIELD QUALITY CONTROL**

- A. Inspect accessible components for cleanliness, mechanical and electrical integrity and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
- B. Store equipment indoors in clean, dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subjected to weather, cover equipment to protect from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside equipment.
- D. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- E. Performance Verification Testing

1. Field inspection and testing will be performed under provisions of Division 01 and Section – Testing Electrical Systems.
2. Perform Visual and Mechanical Inspections listed in NETA Acceptance Testing Specifications applicable to each piece of equipment installed.
3. Verify shunt trip circuit breakers operate as described on Drawings. (For example: upon activation of kitchen hood fire suppression system).
4. Verify proper operation of all AFCI and GFCI circuit breakers with a UL 1436 certified outlet tester.
5. Test proper operation of shunt trip switch. Verify that shunt trip operates upon receiving signal from fire alarm system. Verify that voltage monitoring contacts are operating correctly and fire alarm system interconnection is operating (i.e. does loss of shunt trip voltage create a supervisory alarm on the fire alarm system).
6. Panelboards: Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits. Recheck loads after adjustments during normal load period. Record all load readings before and after adjustments and submit test results.

### **3.05 SYSTEM START UP**

- A. Prior to energizing, verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding" have been met.
- B. Protective Devices:
  1. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish appropriate operation, shall be carried out by the Contractor at no additional cost to the owner.
  2. The Contractors shall perform field adjustments of the protective devices as required to place the equipment in final operating condition.

### **3.06 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Provide Owner Instruction and Demonstration in accordance with the requirements of Division 01 and Section Operation and Maintenance of Electrical Systems.
- B. Connections:
  1. Review manufacturer's recommendations for tightening and checking bolted connections.
  2. Review procedures for properly tightening bolted electrical connections.
  3. Review conductor color code.
- C. Circuit breakers:
  1. Review procedures for operating circuit breakers.
  2. Review adjustable circuit breaker operation and adjustments.
  3. Review ground location of ground fault circuit breakers and shunt trip circuit breakers.
  4. Operation of ground fault protection device(s).
- D. Enclosed Motor Controllers:
  1. Review procedures for setting and resetting enclosed motor controller thermal and short circuit protective devices.
  2. Review procedures for placing equipment into manual and automatic modes.
  3. Review auxiliary control devices and automatic sequence of operations.

### **3.07 DOCUMENTATION**

- A. Provide written certificate(s) and include a copy with the O&M manuals, indicating that the inspections and tests specified herein have been performed, that load balancing has been performed, that Owner

Training and Demonstration, and that the installation is in accordance with these specifications. Certificate shall be signed and dated by Contractor.

- B. If requested provide documentation of date and time field acceptance testing and load balancing have been performed, personnel performing the test, and steps taken to improve failed tests / inspections.
- C. Provide a list of with installed fuses and corresponding fuse type and size (including control power fuses).
- D. Include a list of all equipment with bolted connections indicating manufacturer's recommended torque value, date of initial tightening, date of test / inspection, name of initial and test / inspection personnel.

**END OF SECTION**





## **SECTION 26 2726 - WIRING DEVICES**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Snap switches.
- B. Receptacles:
  - 1. Straight blade receptacles.
  - 2. GFCI type receptacles.
  - 3. USB type straight blade receptacles.
  - 4. Twist-locking receptacles.
- C. Multi-outlet Assemblies.
- D. Cord and Plug Sets.
- E. Device plates and decorative box covers.

#### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26, 27, and 28.
- B. See specification Section 26 0553 Identification for Electrical Systems.

#### **1.03 REFERENCES**

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device - Configurations.
- D. NFPA 70 - National Electrical Code.
- E. UL 20 - General-Use Snap Switches
- F. UL 498 - Attachment Plugs and Receptacles

#### **1.04 QUALITY ASSURANCE**

- A. Obtain each type of wiring device and associated wall plate from a single manufacturer.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

#### **1.05 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 01, and Section – Electrical General Requirements.
- B. Provide manufacturers installation instructions and product data for the following:
  - 1. Snap Switches.
  - 2. Straight Blade Receptacles.
  - 3. Wall Plates.

## 1.06 SUBMITTALS FOR INFORMATION

- A. Submit according to the requirements of Division 01 and Section – Electrical General Requirements.

## 1.07 SUBMITTALS FOR CLOSEOUT

- A. Submit according to the requirements of Division 01 and Section 26 0100.
- B. As-Built Drawings: record deviations from bid documents including additions, omissions, and relocations. Note revised circuit numbers.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. The manufacturer's listed below shall be approved for all products listed below unless noted otherwise.
- B. Device Manufacturers:
  - 1. Bryant Electric Co.
  - 2. Cooper Wiring Devices
  - 3. Crouse Hinds.
  - 4. Eagle Electric Mfg. Co., Inc.
  - 5. Hubbell, Inc.
  - 6. Leviton Mfg.
  - 7. Pass & Seymour, Inc.
- C. Device Plate Manufacturers:
  - 1. Bryant Electric
  - 2. Cooper Wiring Devices
  - 3. Crouse Hinds
  - 4. Hubbell Inc.
  - 5. Leviton Mfg.
  - 6. Pass & Seymour, Inc.
  - 7. Steel City
  - 8. Taymac

### 2.02 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Heavy Duty, AC only general use quiet snap switch.
- C. Rating: 120/277 V, 20A.
- D. Terminal Screws: Back and side wire shall accept #14, #12, and #10 AWG stranded or solid wire. With back and side wire grounding screw.
- E. Exposed Color: Grey.
- F. Toggle Operator (provide key operator in lieu of toggle operator where indicated):
  - 1. Device Body and Handle: Glass reinforced nylon with toggle handle.
  - 2. Indicator (Pilot) Light: Lighted handle type switch red color handle lens.
  - 3. Locator Light: Lighted handle type switch; amber color handle.
  - 4. Voltage Ratings: 120-277 volts, AC.
  - 5. Current Ratings: 20 amperes (30 amperes where indicated or required).

6. Ratings: Match branch circuit and load characteristics.
  7. 1 year warranty.
  8. Multi-way switches with lighted handle (illuminated off). Similar to Leviton 1223 series. Toggle operator shall match device and plate color.
- G. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors
- H. Multi-way switches with lighted handle (illuminated off). Similar to Leviton 1223 series. Handle color to match device and plates.

### **2.03 STRAIGHT BLADE RECEPTACLES**

- A. Comply with UL 498, NEMA WD 1, NEMA WD 6 configuration. NEMA 5-20R; 125V, 20A unless indicated otherwise.
- B. Terminal Screws: Back and side wire shall accept #14, #12, and #10 AWG stranded or solid wire. With back and side wire grounding screw.
- C. Exposed Color: grey.
- D. Description: Heavy-duty general use receptacle.
1. Device Body: Impact resistant thermoplastic.
  2. GFCI Receptacle: UL 943 Class A (6-mA trip) ground fault circuit interrupter receptacle with integral "end of life" LED indicator light and reverse line-load miswire protection. GFCI shall be feed through style. Indicator light that indicates energized status. Hospital grade (Comply with UL 498 supplement SD) where required.
  3. Isolated Ground Receptacle: with orange triangle marking. Equipment grounding contacts shall be connected only to the green ground screw with electrical isolation from the metal mounting strap (isolation not dependant on movable parts).
  4. Hospital Grade: Comply with UL 498 supplement SD, with green dot marking.
  5. Tamper Resistant: Labeled to comply with NFPA 70 (NEC), "Health Care Facilities" and NEC 406.
  6. Weather Resistant: Labeled to comply with NFPA 70 (NEC) 406.8.
  7. Hazardous (Classified) Location Receptacles: Comply with NEMA FB 11 and UL 1010.
  8. 1 year warranty.

### **2.04 USB TYPE RECEPTACLES**

- A. Manufacturer:
1. Cooper Wiring Devices.
  2. Hubbell.
  3. Substitutions according to provisions of Division 01 and Section 26 0000.
- B. Description: Tamper resistant, decorator style, duplex receptacle, 20-amp with dual USB charging ports. Unit has LED indicator light to identify that device is connected.
1. USB charging ports (2 thus): 3.1 amps. 5-volt DC, compatible with USB 2.0 and 3.0 devices.
  2. UL Federal Specification Listed.
  3. UL Listed.
- C. 1-year warranty.

### **2.05 WALL PLATES**

- A. Flush:

1. Stainless steel Type 302, .032" nominal thickness, with brushed finish.
  2. 1 year warranty.
- B. Commercial Kitchen:
1. Stainless steel Type 302, .032" nominal thickness, with brushed finish.
  2. 1 year warranty.
- C. Surface Dry Location Steel:
1. Galvanized steel with rounded edges and corners that match edges of surface boxes.
  2. Do not install flush covers to surface boxes.
- D. Surface Cast metal for FS and FD type boxes. Do not install flush covers to surface boxes;
- E. Weatherproof Steel Cover:
1. Exterior, UL listed with cord and plug connected (in-use rated).
  2. Die cast metal, gray powder coat finish, flip-top lid.
  3. Shallow 3.5" max depth. Deep 5" max depth.
- F. Weatherproof Cover:
1. Spring load, non-in use rated.
  2. Die-cast metal, gray power coat finish.
  3. Use non-in use rated covers only where specifically noted.
- G. Weatherproof Switch Cover:
1. UL Listed, stamped aluminum cover.
  2. Handle type operator.
- H. See also Section – Raceway and Boxes for Weatherproof recessed boxes.

## 2.06 MULTIOUTLET ASSEMBLIES

- A. Manufacturers:
1. Wiremold
  2. Other manufacturers complying with requirements.
- B. Raceway Material: Metal, with manufacturer's standard gray finish.
- C. Wire: No. 12 AWG.
- D. Plugmold Type (Wiremold 2000 series): Two piece construction, 3', 5' or 6' as indicated, receptacle spacing 6", 12", 18", 30", or 60" as indicated.
- E. Medium Size (Wiremold 3000 series): Two piece construction, single channel, factory wired, approximate cross section dimensions of 2.75" x 1.5," length as indicated:
1. Flush mounting plates configured for device mounting with standard plates.
  2. One, two, or three pole circuit breakers mounted integral to unit.
  3. Outlets spaced as indicated.
- F. Large Size (Wiremold 4000 series): Two piece construction, dividable into two equal size compartments, approximate cross section dimensions of 4.75" x 1.75," length as indicated:
1. Flush mounting plates configured for device mounting with standard plates.
  2. Receptacles shall be factory mounted with wire leads.

3. Outlets spaced as indicated.
- G. Stainless Large Size (Wiremold S4000 series): Two piece construction, dividable into two equal size compartments, approximate cross section dimensions of 4.75" x 1.75," length as indicated:
  1. Flush mounting plates configured for device mounting with standard plates.
  2. Receptacles shall be factory mounted with wire leads.
  3. Outlets spaced as indicated.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

### **3.02 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt and debris.
- C. Install wiring devices after wiring work is completed.
- D. Coordinate locations of outlet boxes provided under Section – Raceways and Boxes for Electrical Systems to obtain mounting heights specified and indicated on drawings.
- E. In locations where several pieces of wall-mounted equipment such as wall switches and thermostats are in the same general area, all shall be installed and grouped in a neat, orderly fashion, all of the same horizontal or vertical center line, whichever the case may be. Variation from this direction shall be approved by the owner or the owner's representative.
- F. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on Drawings. Prior to roughing-in for devices, the contractor shall check with other contractors concerned to determine exact field locations.
  1. Check doors swings to ensure proper location of switches.
  2. Check with mechanical contractor for coordination with perimeter heating systems.
  3. Adjust locations of floor outlets and service poles per arrangement of modular furniture.

### **3.03 INSTALLATION**

- A. Install in accordance with NECA "Standard of Installation" and manufacturer's instructions.
  1. Install devices plumb and level.
  2. Install switches with OFF position down.
  3. Do not gang switches with dimmers.
  4. Connect devices to branch circuits using pigtails not less than 6" long.
  5. Receptacles shall be installed such that removal of the receptacle does not interrupt continuity of the circuit.
  6. Wrap terminal screws with at least two layers of PVC electrical tape.
  7. Connect wiring device grounding terminal to outlet box with bonding jumper or branch circuit equipment grounding conductor where such conductor is specified or required or indicated.

8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
  9. Connect wiring devices by wrapping conductor around screw terminal.
  10. Where ganged switches serving 277V lighting are served by different circuits, so as to result in the voltage between switches exceeding 300V, provide barriers in box per NEC.
- B. Wall Plate Installation:
1. Install wall plates after painting has been completed.
  2. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
  3. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
  4. Use jumbo size plates for outlets installed in masonry walls.
- C. Where more than one wiring device occurs in any one location, arrange devices in gangs with common cover plate.
- D. Receptacle Orientation:
1. Install receptacles with grounding pole on bottom.
- E. Install tamper resistant devices in spaces as required by the NEC, including elementary school areas.
- F. Install GFCI receptacles where located in bathrooms, kitchens, garages, outdoors, or within six feet of water source.
- G. Install weather resistant devices in all Damp and Wet locations per NEC 406.8.
- H. Identify devices according to provisions of Section – Identification for Electrical Systems.
1. Switches: Where more than two switches are ganged (and where elsewhere indicated) provide engraved wall plate, verify with Owner, or Architect prior to engraving.
  2. Receptacles: Identify panelboard and circuit number serving device. Black filled lettering on clear background.

### **3.04 MULTI-WAY SWITCHES**

- A. Unless noted otherwise, multi-way switches ganged together in groups of 3 or more shall have lighted handle (illuminated off). Toggle operator shall match device and plate color.

### **3.05 FIELD QUALITY CONTROL**

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test GFI receptacles with a UL 1436-certified outlet circuit tester to verify correct operation.
- F. Replace all devices that have been in temporary use during construction or that show signs that they were installed before the building finishes were complete.
- G. Adjust devices and wall plates to be flush and level.

### **3.06 DOCUMENTATION**

- A. Provide certificate(s) according to requirements of specification section – Operation and Maintenance of Electrical Systems indicating that Owner Training and Demonstration has taken place.

### **3.07 CLEANING**

- A. Clean exposed surfaces to remove splatters and restore finish.

**END OF SECTION**





# SECTION 26 4300 - SURGE PROTECTIVE DEVICES

## PART 1 GENERAL

### 1.01 SECTION INCLUDES:

- A. Surge Protective Devices.

### 1.02 RELATED DOCUMENTS

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26, 27, and 28.
- B. See Section 26 2000 Low Voltage Electrical Distribution Equipment.

### 1.03 REFERENCES

- A. ANSI/IEEE C62.41.1 - IEEE Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
- B. ANSI/IEEE C62.41.2 – IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
- C. ANSI/IEEE C62.45 - IEEE Guide on surge testing for equipment connected to low-voltage AC power circuits.
- D. MIL-STD-220B – Test Method Standard Method of Insertion Loss Measurement.
- E. NFPA 70 – National Electrical Code.
- F. UL 1283 - Electromagnetic Interference Filters.
- G. UL 1449 (3<sup>rd</sup> Addition) - Surge Protective Devices.

### 1.04 DEFINITIONS / TERMS / ACRONYMS

#### A. Acronyms

1. ANSI – American Northern Standards Institute
2. IEEE – Institute of Electrical and Electronic Engineers
3. NFPA - National Fire Protection Agency
4. SPD – Surge Protective Device
5. UL – Underwriter’s Laboratory.

#### B. Definitions

1. Coordinated facility system -
2. Type 1 SPD (per UL 1449) - Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and Molded Case SPDs intended to be installed without an external overcurrent protective device.
3. Type 2 SPD (per UL 1449) - Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel and Molded Case SPDs.
4. Type 3 SPD (per UL 1449) – Point of utilization SPDs, installed at a minimum conductor length of 10 meters (30 feet) from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being

- protected. See marking in 80.3. The distance (10 meters) is exclusive of conductors provided with or used to attach SPDs.
5. Lightning Scenario I (see ASNI/IEEE C62.41.1 for additional information) – Lightning flash not directly involving the structure.
  6. Lightning Scenario II (see ASNI/IEEE C62.41.1 for additional information) – Lightning flash direct to the structure or to the earth very near the structure.
  7. Location Category A (see ASNI/IEEE C62.41.1 and C62.41.2 for additional information) – applies to parts of the installation at some distance from the service entrance, at the ends of long branch circuits.
  8. Location Category B (see ASNI/IEEE C62.41.1 and C62.41.2 for additional information) – applies to the parts of the installation at the service entrance, ends of major feeders, and short branch circuits.
  9. Location Category C (see ASNI/IEEE C62.41.1 and C62.41.2 for additional information) – applies to the parts of the installation outside the facility.

### **1.05 QUALITY ASSURANCE**

- A. The installation of surge protective devices in or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.
- B. Prior to installation Contractor shall review the manufacturer's installation instructions and NFPA 70 Article 285 to become familiar with installation requirements.
- C. Products:
  1. All devices specified herein shall be obtained through a single manufacturer.
  2. Comply with NFPA 70. (Per NEC Article 285, the devices shall be marked with the short circuit current rating.) Test data shall be provided when requested to demonstrate the short circuit current rating has been tested on a complete device.
  3. Furnish products listed and classified by UL as suitable for purpose specified and indicated.
  4. Comply with UL 1283, and UL 1449.
- D. Manufacturer: The SPD's shall be manufactured by a manufacturer that has been regularly engaged in the design, manufacturing and testing of SPD's of the types and ratings required for a period of not less than ten years.
- E. Test Laboratory:
  1. Manufacturer's test laboratory shall be certified under a nationally recognized test laboratory's Client Test Data Submittal Program to conduct testing in accordance with UL 1449 and UL 1283.
  2. Manufacturer's test laboratory shall be certified under a nationally recognized test laboratory's Client Test Data Submittal program to conduct testing in accordance with IEEE C62.41 and C62.45.
  3. Or test data shall be provided as noted above from a nationally recognized third party test laboratory.

### **1.06 WARRANTY**

- A. The SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for 10 years.
- B. An SPD that shows evidence of failure or incorrect operation during the warranty period shall be replaced free of charge. The warranty must specifically provide for unlimited free replacements in the event of failure caused by the effects of lightning and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

### **1.07 SUBMITTALS FOR REVIEW**

- A. Submit according to provisions of Division 01 and Section – Electrical General Requirements.

- B. Provide manufacturers installation instructions, factory test reports, and product data for each product specified.
- C. Product data shall clearly show all information indicated in Section – Electrical General Requirements and the following:
  - 1. UL 1449 3<sup>rd</sup> Addition voltage protection ratings.
  - 2. UL 1449 3<sup>rd</sup> Addition 20 kA nominal type 1, complimentary listed type 2 with UL 1283 filtering certification.
  - 3. Suggested lead conductor size, type, and length as well as suggested installation limitations (e.g. bend limits on conductors, maximum acceptable lead lengths).
  - 4. Indicate maximum size of circuit breaker or fuse to be connected to each unit.
  - 5. Warranty period and replacement terms.

#### **1.08 SUBMITTALS FOR INFORMATION**

- A. Submit according to provisions of Division 1 and Section – Electrical General Requirements.
- B. Test reports complying with the requirements of the Quality Assurance paragraph above indicating:
  - 1. ANSI/IEEE let through voltages for each product provided.
  - 2. ANSI/UL 1449 Third Edition compliance.
  - 3. Noise Attenuation.
  - 4. Surge current capacity.

#### **1.09 SUBMITTALS FOR CLOSEOUT**

- A. Submit according to the requirements of Division 01 and Section 26 0100.
- B. As-Built Drawings: Record final locations of components.
- C. Operation and Maintenance Manuals: Include edited copy of submittals for review. Include manufacturers instruction manual and suggested maintenance procedures.

### **PART 2 PRODUCTS**

#### **2.01 SPD GENERAL REQUIREMENTS**

- A. The SPD shall protect all modes L-G, L-N, L-L, and N-G, have discrete suppression circuitry in L-G, L-N, and N-G, and have bidirectional, positive and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified, and accordingly reduced mode units with suppression circuitry built into only 4 modes are not acceptable. In delta systems, line-to-ground-to-line protection is not acceptable where line-to-line is specified.
- B. Fusing: All suppression components shall be metal oxide varistors (MOV), minimum of 7, matched to plus or minus 1 volt per module, individually fused and rated to allow maximum specified surge current capacity. Devices that utilize a single fuse to protect two or more suppression paths are not excepted. Individual surge components shall be sand packed and shall be UL listed to be capable of interrupting up to 200 kA symmetrical fault current with 480 VAC applied. Replaceable fusing is unacceptable. Thermally protected, or thermal cutout metal oxide varistors (TPMOV's) shall not be allowed. Overcurrent protection that limits specified surge currents is not acceptable. 200kA short circuit rating.
- C. Operating Frequency Range: 47 Hz – 63 Hz minimum.
- D. The maximum continuous operating voltage (MCOV) of all components shall not be less than:
  - 1. 125% for 120-volt systems.

- 2. 115% for all other systems.
- E. SPD's shall be equipped with a monitoring circuitry which shall continually verify the protection status during operation and display this status on the front cover display. Integrity of all fuses must be indicated on the status display.
- F. Status of each individual internal surge module must be visually indicated and externally viewable.
- G. The following detection and monitoring circuits shall be provided:
  - 1. Equipped 70% under-voltage detection.
  - 2. Equipped with phase loss monitoring.
  - 3. Equipped with power loss monitoring.
- H. If a disconnect switch is specified, the disconnect switch and the SPD as a system shall be capable of interrupting up to a 200kA symmetrical fault current with 600 VAC applied.
- I. SPD's shall be separate from distribution equipment. Integral SPD's shall not be acceptable.

## 2.02 SERVICE ENTRANCE SPD

- A. Manufacturer:
  - 1. Total Protection Solutions Service Track series.
  - 2. Emerson/Liebert 570 series.
  - 3. Current Technologies SL3 series.
  - 4. Substitutions: According to Division 01, and Section – Electrical General Requirements, and as noted above. Submit test reports complying with requirements listed under Quality Assurance Paragraph and under Submittals for Information.
- B. Application:
  - 1. UL 1449 3<sup>rd</sup> Addition Location: Type 1.
  - 2. ANSI/IEEE C62.41.1 Location Category: B and C.
- C. UL 1449 3<sup>rd</sup> Addition Nominal Discharge Current: 20 kA.
- D. Life Cycle Testing Results: 8,000 per mode.
- E. UL 1449 3<sup>rd</sup> Edition Voltage Protection Ratings (208Y/120):
  - 1. Line to Neutral: 800V
  - 2. Line to Ground: 900V
  - 3. Line to Line: 1200V
  - 4. Neutral to Ground: 700V
- F. Surge Rating:
  - 1. 125kA /mode unless indicated otherwise
- G. Unit shall be tested in accordance with ANSI/IEEE C62.45 for location Category B and C surge Scenarios I and II (standard tests only). Test reports shall be provided. A device shall be deemed acceptable provided the test results indicate "No Observed Change" in the performance of the device for the standard waveforms and peak values of those waveforms described in ANSI/IEEE C62.41.2.
- H. Enclosure: NEMA 4 for exterior locations, NEMA 1 or 12 for indoor locations.
- I. Features and Accessories
  - 1. Auxiliary contacts for remote monitoring of suppressor status.

2. Audible alarm with silence button.
3. Surge Counter.

### **2.03 PANELBOARD SPD**

- A. Manufacturer:
  1. Total Protection Solutions Low Profile series.
  2. Emerson / Liebert 510 series.
- B. Application:
  1. UL 1449 3<sup>rd</sup> Addition Location: Type 1 and 2.
  2. UL 1283.
  3. ANSI/IEEE C62.41.1 Location Category: B.
- C. UL 1449 3<sup>rd</sup> Addition Nominal Discharge Current: 20 kA.
- D. Life Cycle Testing Results: 8,000 per mode.
- E. The filter shall provide an attenuation of 63 db max from 10 kHz to 100MHz, per 50 Ohm Insertion Loss Methodology from MIL 220A.
- F. UL 1449 3<sup>rd</sup> Edition Voltage Protection Ratings (208Y/120):
  1. Line to Neutral: 600V
  2. Line to Ground: 700V
  3. Line to Line: 900V
  4. Neutral to Ground: 600V
- G. Surge Rating: 60 kA / mode unless indicated otherwise
- H. Unit shall be tested in accordance with ANSI/IEEE C62.45 for location Category B surge Scenarios I and II (standard tests only). Test reports shall be provided. A device shall be deemed acceptable provided the test results indicate "No Observed Change" in the performance of the device for the standard waveforms and peak values of those waveforms described in ANSI/IEEE C62.41.2.
- I. Enclosure: NEMA 4 for exterior locations, NEMA 1 or 12 for indoor locations.
- J. Features and Accessories
  1. Auxiliary contacts for remote monitoring of suppressor status.
  2. Audible alarm with silence button.
  3. Surge Counter.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Receive, inspect, handle and store surge suppressors in accordance with manufacturer's instructions.
- B. Examine surge suppressors before installation and reject those which are damaged.
- C. Examine location of surge suppressor installation for compliance with installation tolerances and other conditions affecting performance of Work.

### **3.02 PREPARTION**

- A. Contractor shall review the manufacturer's installation instructions and NFPA 70 Article 285 to become familiar with installation requirements.
- B. Locate associated equipment as required to ensure installation complies with manufacturer's installation requirements and NFPA 70.

### **3.03 INSTALLATION**

- A. Install equipment in accordance with manufacturer's instructions.
- B. Provide surge protection device panels where shown on the drawings.
- C. Install device immediately next to or on top of the distribution equipment served and connect to equipment as recommended by the manufacturer.
  - 1. Keep conductors between suppressors and points of attachment as short and straight as possible.
  - 2. Provide multi-pole 30, 60, or 100-A circuit breaker as dedicated disconnect for the suppressor, unless noted otherwise.
  - 3. Do not exceed manufacturer's recommended lead length.
- D. Complete all conduit and conductor connections. Grounding suppressor shall be bonded to the equipment grounding conductor system.
- E. Do not energize or connect service entrance equipment or panelboards until surge protection devices have been installed and connected.

### **3.04 FIELD QUALITY CONTROL**

- A. Inspection and testing will be performed under provisions of Division 01 and Section – Testing Electrical Systems.
- B. Perform visual and mechanical inspections listed in NETA Acceptance Testing Specifications.

### **3.05 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Provide Owner Instruction and Demonstration in accordance with the requirements of Division 01 and Section Operation and Maintenance of Electrical Systems.
- B. Review locations of all surge protective devices.
- C. Review Warranty terms.
- D. Review device operation (e.g. warning lights).

### **3.06 DOCUMENTATION**

- A. Provide written certificate(s) and include a copy with the O&M manuals, indicating that the inspections and tests specified herein have been performed, that Owner Training and Demonstration, and that the installation is in accordance with these specifications. Certificate shall be signed and dated by Contractor.

### **END OF SECTION**

# **SECTION 26 5100 - LIGHTING FIXTURES AND LUMINAIRES**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Lighting fixtures, luminaires and accessories, ballasts, lamps, exit signs.
- B. Exterior Luminaires, poles and accessories.
- C. Emergency lighting units.
- D. Fluorescent dimming ballasts and controls.
- E. Accessories.

### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and other sections of Division 26, 27, and 28.
- B. See Section 26 0100 Electrical Systems Close Out Documentation.
- C. See Section 26 0920 Lighting Control Devices and Systems.

### **1.03 REGULATORY REQUIREMENTS**

- A. Provide products and installation according to the requirements of ANSI/NFPA 70.
- B. Provide products and installation according to the requirements of NFPA 101.

### **1.04 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years documented experience.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

### **1.05 WARRANTY**

- A. Warranty for Emergency Lighting Units: Manufacturer agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within warranty period.
  - 1. Emergency Lighting Unit and Electronics: 3 years full.
  - 2. Emergency Lighting Unit Battery Warranty: 6 years. Full warranty for 3 years, pro rata for final 3 years.
  - 3. Self-Powered Exit Sign: 5 years full.
- B. Warranty for Fluorescent Electronic Ballasts:
  - 1. Electronic Ballasts: 5 years from date of manufacturer against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C.
- C. Warranty for Low Voltage Transformers: Manufacturer agrees to replace transformers that fail in materials or workmanship within specified warranty period.
  - 1. Transformers provided as a track head accessory or integral to a track head: manufacturer's standard warranty, but not less than one year from date of manufacture.

2. For remote magnetic transformers: manufacturer's standard warranty, but not less than twenty-five years from date of manufacture
- D. Warranty for LED Drivers: 5 years from date of manufacturer against defects in material or workmanship, for operation at a maximum case temperature of 70C.

#### **1.06 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 1 and Section – Electrical General Requirements.
- B. Provide manufacturer's catalog data for each piece of equipment specified.
  1. Where products are scheduled for finish to be selected by Architect include color selection chart. Where finish is indicated to be metallic finish selected by Architect include finish samples.
  2. Provide shop drawings for non-standard products.
- C. Submittal shall include at the front on dedicated page(s): Table indicating designation (i.e. type A, B, C, etc.), manufacturer, series, lamp manufacturer and catalog number, and ballast manufacturer and catalog number (if a specific ballast manufacturer cannot be named included list of possible ballasts).
- D. SUBMITTALS WILL NOT BE ACCEPTED WITHOUT BALLAST AND LAMP DATA.
- E. Shop Drawings:
  1. Provide for nonstandard or custom luminaires and exterior pole / post mounted luminaires. Indicate dimensions, weights, method of field assembly, components, features, and accessories. Include control and power wiring diagrams.
  2. Provide manufacturer certified anchor bolt templates for specific poles.

#### **1.07 SUBMITTALS FOR INFORMATION**

- A. Submit according to the requirements of Division 1 and Section – Electrical General Requirements.
- B. Submit the following:

#### **1.08 SUBMITTALS FOR CLOSEOUT**

- A. Submit according to the requirements of Division 01 and Section 26 0100.
- B. Operation and Maintenance Manuals include information noted in section Operation and Maintenance Manuals for Electrical Systems and the documentation required by Part 3.

### **PART 2 PRODUCTS**

#### **2.01 LIGHTING FIXTURES AND LUMINAIRES**

- A. Provide products as scheduled.
- B. Substitutions under provisions of Section – Electrical General Requirements
- C. Install ballasts, and specified accessories at factory.
- D. Where painted finishes are indicated or required for luminaires and lighting fixtures; paint shall be applied to parts after fabrication and prior to assembly. Painting process shall include coverage of surfaces including edges and corners. In general, prepainted metals are not acceptable for lighting fixture assemblies, parts or units.



- E. 1x4, 2x2 and 2x4 grid troffers shall be provided with hinged doors with spring latches and screw held body end plates (not less than 2 screws per end plate).
- F. 1x4, 2x2 and 2x4 flanged troffers shall be provided with wing hangers and plaster frames for dry wall installation.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and arranged to permit relamping without tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental failure when relamping and when secured in operating position.
- H. Foam tape light leak gasketing is not acceptable for grid and flanged troffers. Utilize plastic baffles, multiple corners and other acceptable means for light leak control.
- I. Asbestos bearing materials are not acceptable.

## **2.02 LED LUMINAIRES**

- A. Photometric measurements indicated on product data shall be provided in accordance with IESNA LM-79-08 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products and shall meet the requirements specified and / or indicated on the Drawings.
- B. Lumen data indicated on product data sheets shall be generated in accordance with IESNA LM-80-08 IES Approved Method for Measuring Lumen Maintenance of LED Light Sources and shall meet the requirements specified and / or indicated on the Drawings.
- C. Lumen depreciation shall be identified in terms of IES TM-21-11. Unless noted otherwise, luminaires shall provide a minimum L70 rating at the drive current provided product data shall indicate such.
- D. Correlated color temperature (CCT) indicated on the product data sheets shall be provided in accordance with ANSI C78.377-2008 American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting (SSL) Products and shall meet the requirements specified and / or indicated on the Drawings.
- E. Lumen output specified shall be lumens delivered from the luminaire at the color temperature specified.
- F. Luminaires efficacy shall meet that specified / scheduled at the CCT specified.

## **2.03 LED DRIVERS**

- A. Drivers shall be universal voltage (120-277 volt) or shall be 208 volt, or 480 volt as required to meet project conditions.
- B. Drivers shall be provided with protection against a transient line surge as noted on the Drawings.
- C. Drivers shall be equipped with quick disconnect.
- D. Power factor > 0.9.
- E. Harmonic distortion < 20%.
- F. Ambient temperature range: 104 degrees F to -30 degrees F.
- G. UL listed.

## **2.04 INCANDESCENT EMERGENCY LIGHTING UNITS**

- A. Provide products as scheduled.

- B. Description: Self-contained units complying with UL 924.
  - 1. Battery: Sealed, maintenance-free, lead acid type.
  - 2. Charger: Fully automatic, solid state type with sealed transfer relay.
  - 3. Lamp is automatically turned on when supply voltage drops below 80 percent of nominal voltage. Lamp automatically disconnects when battery reaches low voltage. When normal voltage is available, relay disconnects lamps, and battery is automatically recharged.
  - 4. Test Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge, bright glow indicates charging at end of discharge cycle.
  - 6. Wire Guard: Heavy-chrome plated wire guard protects lamp heads. Provide where indicated.
  - 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is returned after an outage.
  - 8. Integral Self-Diagnostic: Factory installed device automatically initiates code required test of unit emergency operation. Test failure is indicated LED.

## 2.05 EXIT SIGNS

- A. Provide products as scheduled with LED lamps.
- B. Description: Comply with UL 924 and with authority having jurisdiction.
- C. Internally Lighted, Self-Powered Exit Signs (Battery Type):
  - 1. Sealed maintenance free, nickel cadmium type battery.
  - 2. Fully automatic, solid state type charger with sealed transfer relay.
  - 3. LED strip is automatically turned on when supply voltage drops below 80 percent of nominal voltage. Lamp automatically disconnects from battery when voltage approaches deep discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
  - 4. Push-to-test in housing.
  - 5. LED Indicator Light.
  - 6. Wire Guard: Provide where indicated.
  - 7. Integral Self-Diagnostic: Factory installed device automatically initiates code required test of unit emergency operation. Test failure is indicated LED.

## 2.06 POLE OR POST MOUNTED LIGHTING

- A. Structural Performance: Provide luminaires and poles capable of withstanding the effects of the following loads and stresses indicated under the applicable conditions:
  - 1. Dead Load: Weight of luminaire and its horizontal and vertical supports, and accessories in accordance with AASHTO LTS-4.
  - 2. Ice Load: In accordance with AASHTO LTS-4.
  - 3. Wind Loads: In accordance with AASHTO LTS-4, velocity for poles is 90 mph.
- B. Anchoring: Provide anchoring of poles as noted on drawings and in accordance with manufacturer's instructions.
- C. Provide vibration dampeners in all posts/poles.
- D. Post/poles shall have hand holes near base.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrate and supporting grids for luminaires.
- B. Examine each luminaire to determine suitability for lamps specified.

### **3.02 PREPARATION**

- A. Verify that luminaires are of the types specified and approved for the application. Advise the Architect if any luminaires appear to incorrect type or indicated for incorrect application, wrong voltage, or not properly listed for intended application.
- B. Verify that luminaire mounting types are compatible with ceiling systems. Advise the Architect of conflicts.
- C. Verify that Work is sufficiently complete to allow installation.
- D. Verify that structural supports are in place.
- E. Coordinate installation with other trades.
  - 1. Do not install luminaires where known conflicts exist.
  - 2. Review the reflected ceiling plan for conflicts. Advise the Architect of any identified conflicts, request additional information if systems and / or devices are not coordinated.
  - 3. In general luminaires should take precedence over other devices.
  - 4. Coordinate the installation of recessed luminaires with ceiling contractors.
- F. Verify lamp and ballast specified on Drawings are compatible with each other and luminaire.

### **3.03 INSTALLATION**

- A. Install in accordance with NECA/IESNA 500 and manufacturer's instructions.
- B. Handle luminaires and fixtures carefully. Do not install damaged or bent units; do not install cracked or broken lenses; replace with new units and lenses.
- C. Connect luminaires to branch circuit outlets using flexible conduit. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire. Bond products and metal accessories to branch circuit equipment grounding conductor.
- D. Locate luminaires as indicated on reflected ceiling plan.
- E. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- F. Maintain required clearances between fixtures recessed fixtures and insulation.
- G. Hangers and Supports:
  - 1. Support luminaires in accordance with manufacturer's instructions.
  - 2. Provide supporting members independent of the ceiling system and ceiling support system.
- H. Pendant mounted luminaires
  - 1. Use pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

2. Flexible conduit shall be provided for each chain suspended fluorescent fixture. Flex shall be fastened neatly to chain with plastic "tie wrap" devices. Alternative type "SO" rubber cords, receptacles and twist lock plugs may be provided in lieu of flex conduit.
  3. Pendant-hung lighting fixtures shall be supported directly from the structure above using threaded rods, washers and double nuts (or approved alternate support) without using the ceiling suspension system for direct support.
- I. Luminaires recessed in suspended ceilings.
1. Confirm adequate clearance.
  2. Secure luminaire to ceiling system using grid clips or screws.
  3. Install to permit removal from below.
  4. Support troffer luminaires with a 12 gauge wire from each corner of the luminaire to the structure above.
- J. Downlights
1. Install the trim using cotton gloves.
  2. Place the trim to fully cover the opening and prevent light leaks.
  3. Secure the housing to the ceiling suspension system using hanger bars or C-channels.
  4. At suspended ceilings
    - a. Determine exact location of luminaires used for wall washing and accent lighting. These luminaires are not necessarily to be installed at the center of the ceiling tile.
    - b. Cut hole in ceiling tile carefully, making sure that the luminaire flange will completely cover the opening.
    - c. Ensure that the weight of the system is not supported by the ceiling tile.
    - d. Adjust the luminaire so that the flange is flush with the ceiling surface.
    - e. Support luminaire to the structure above with at least one #12 gauge wire.
  5. At inaccessible ceilings
    - a. Provide extension rings if necessary to compensate for ceiling thickness.
    - b. Provide sloped ceiling adapters where necessary.
    - c. Provide supports so that no fixture weight is imposed on any plaster or gypsum board
- K. Recessed fluorescent troffers at inaccessible ceilings ensure framing is provided along all four sides of the luminaire. Provide supports so that no fixture weight is imposed on any plaster or gypsum board. Provide flanged troffers or provide troffers with flange frame.
- L. Continuous row trough and wall slot luminaires: Coordinate installation closely with the ceiling contractor.
- M. Surface and Suspended Lighting
1. Install a minimum of one support at each joint. Install additional supports required to provide stable installation.
  2. Use factory approved suspension method identified on Drawings.
  3. Suspend to height identified on Drawings. If height is not identified coordinate height with Architect.
  4. Secure outlet boxes to building structure by threaded rod or wire suspension.
  5. At exposed structure without finished ceilings secure outlet box directly to structure or provide structural member anchored suitably for luminaire weight and forces.
  6. For Suspended Direct, Indirect, Semi-Indirect, Direct / Indirect Lighting secure power feed cord to support wire with factory provided cord management device.
- N. Surface mounted luminaires:
1. Install surface mounted luminaires plumb and adjust to align with building lines and with each other.
  2. Secure to prohibit movement.

3. Install wall mounted luminaires, emergency lighting units, and exit signs at height indicated on Architectural Drawings. If no height is indicated on Architectural Drawings coordinate mounting height with Architect.
  4. Support surface mounted luminaires on grid ceiling directly from building structure. Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips to prevent lateral movement.
  5. Lightweight surface mounted incandescent fixtures may be supported from their outlet boxes.
  6. Install additional screws into structure as required to stabilize luminaire.
- O. Pole / Post mounted luminaires:
1. Install poles plumb. Provide double nuts to adjust plumb.
  2. Grout around each base.
  3. Bond luminaires, metal accessories, and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.
  4. Provide soil compacting around base.
  5. Provide Ductseal to seal all conduits at base.
  6. Do not install poles without first installing luminaires.
- P. Track Lighting
1. Install a minimum of one support at each joint and 4' on center. Install additional supports required to provide stable installation.
  2. Use factory approved support method for mounting method identified on Drawings.
  3. Secure outlet boxes to building structure by threaded rod or wire suspension.
  4. At exposed structure without finished ceilings secure outlet box directly to structure or provide structural member anchored suitably for luminaire weight and forces.
  5. Do not install track until ceiling painting is complete.
  6. For track not mounting with the opening parallel to the floor, provide additional support to keep track from twisting.
- Q. Support: It shall be the responsibility of the Contractor to provide proper code approved suspension devices and to support all lighting fixtures installed on this project.
- R. For luminaires with integral emergency power locate indicating devices in readily visible area approved by the Architect.
- S. Lamping: Provide lamps of the same manufacturer, color temperature, and CRI unless otherwise specified.
- T. Identification: For luminaires with remote emergency power source identify fixture with red dot of size identifiable and approved by Architect.

### **3.04 FIELD QUALITY CONTROL**

- A. Receiving, Storage, and handling:
1. Unload equipment carefully, visually inspect packaging for physical damage. Notify shipper and manufacturer immediately if damage has occurred.
  2. Leave packing material intact or restore to original condition after inspection until ready for installation.
  3. Move luminaires and accessories as few times as possible.
  4. Store materials in a clean, dry location. Avoid spaces subject to moisture accumulation, and / or significant airborne dust or dirt. If such location is not available store materials raised above the floor and wrap in protective plastic sheeting.
  5. Protect against physical damage.

- B. Pole mounted Luminaires' delivery, storage, and handling:
  - 1. Store light fixture poles / posts on decay resistant skids, a least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide air circulation.
  - 2. Retain factory applied pole wrappings on metal parts until right before pole installation. For with nonmetallic finishes, handle with web fabric strips (in lieu of chains).
- C. Performance Verification Testing: Emergency lighting - Test emergency lighting that is intended for means of egress in accordance with NFPA 101, Section 7-9. Confirm the emergency lighting system operates for a minimum of 90 minutes and emergency illumination satisfies NFPA 101, Section 7-9, specified levels.

### **3.05 START UP AND COMMISSIONING**

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- B. Operate fluorescent and high intensity discharge lamps at 100% light output for 100 hours upon initial energization.
- C. Adjusting:
  - 1. Aim and adjust luminaires as directed.
  - 2. Adjust exit sign directional arrows as indicated.
- D. Repair or replace defective components.

### **3.06 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Review procedures for lamp replacement at each luminaire.
- B. Review manufacturer's suggestions for lamp replacement (for example: group re-lamping, scheduled re-lamping, etc.)
- C. Review luminaires with remote ballasts, transformers, LED drivers, etc.
- D. Review different ballast types installed. Review ballasts with different ballasts factors and starting methods.

### **3.07 DOCUMENTATION**

- A. Provide certificate(s) according to requirements of specification section – Operation and Maintenance of Electrical Systems indicating:
  - 1. Owner Training and Demonstration has taken place.
  - 2. Luminaire adjustment (aiming) has taken place.

### **3.08 CLEANING**

- A. Clean electrical parts to remove dirt, construction debris, scraps, conductive and deleterious materials.
- B. Remove dirt and debris from enclosure.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up scratch damage.

### **3.09 REBATE FORMS**

- A. Contractor shall obtain Xcel Energ's rebate forms, complete applicable sections, include invoices and other substantiation as required, and submit to Owner, 1) Lighting Retrofit Rebate Application, and 2) New Construction Rebate Application.

**END OF SECTION**





# **SECTION 27 0528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

## **PART 1 GENERAL**

### **1.01 SECTION INCLUDES**

- A. Pathways include
  - 1. Cable Tray.
  - 2. Conduit and Backboxes.
  - 3. Hangers and Supports.
  - 4. Non-continuous Cable Supports.
- B. Cabling pathway for the following:
  - 1. Voice and Data Cabling.
  - 2. Overhead Paging Cabling.

### **1.02 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26, 27, and 28.
- B. See Section 26 0100 Electrical Systems Close Out Documentation.
- C. See Section 26 0533 Raceway And Boxes For Electrical Systems.

### **1.03 REFERENCES**

- A. Provide Work and Products in accordance with the following standards:
  - 1. NFPA 70 National Electrical Code
  - 2. ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.
  - 3. ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.
  - 4. NEMA VE-2-2006 – Cable Tray Installation Guidelines

### **1.04 QUALITY ASSURANCE**

- A. Contractor shall obtain and review NEMA VE-2-2006.

### **1.05 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 1 and Section – Electrical General Requirements.
- B. Provide submittal for each product specified.

### **1.06 SUBMITTALS FOR INFORMATION**

- A. Submit according to the requirements of Division 1 and Section – Electrical General Requirements.
- B. Submit the following:

### **1.07 SUBMITTALS FOR CLOSEOUT**

- A. Submit according to the requirements of Division 1 and Section 26 0100.
- B. Operation and Maintenance Manuals: Include copy of the approved and edited (i.e. documents have been edited to reflect review comments) submittals for review.

- C. Record Drawings: Indicate actual route of and locations of cable tray, non-continuous cable support systems, and conduits 1-1/4" and larger. Indicate actual locations of outlets. Include description of installed grounding and bonding system, note locations of connections to grounding electrode system and / or building steel system.

## **PART 2 PRODUCTS**

### **2.01 HANGERS AND SUPPORTS**

- A. As specified in section – Basic Electrical Materials and Methods.

### **2.02 NON-CONTINUOUS CABLE SUPPORT SYSTEM**

- A. Manufacturer: Erico CableCat or Equal.

- B. Description:

1. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; UL Listed.
2. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
3. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
4. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
5. Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.
6. Non-continuous cable supports shall be ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.

- C. Type: (Adjustable)

1. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; UL Listed.
2. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
3. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
4. Acceptable products: ERICO CADDY CableCat™ CAT425; or approved equal

- D. Type: (Multi Tiered)

1. Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; UL Listed.
2. If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
3. The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCat™ J-Hooks with screws; or approved equal.
4. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.

- E. Cable Tie Type: Equal to Panduit Extra-heavy cable tie mounts.

- F. Cable Tie and Loop: Equal to Panduit Tak-Ty hook and loop cable tie mounts.
- G. Accessories
  - 1. Cable Pulley
    - a. Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.
    - b. The pin and roller assembly must be removed after cables are installed.
    - c. Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR, or approved equal.
  - 2. Cable Protector
    - a. The protective steel tube shall fit over threaded rod and be at least 4" in length.
    - b. The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.
    - c. Acceptable products: ERICO CAT-CMTM CATTBCM, or approved equal.

### **2.03 CONDUIT AND BACKBOXES**

- A. As specified in Section – Raceway and Boxes for Electrical Systems.

### **2.04 CABLE RUNWAY**

- A. Manufacturer:
  - 1. Hoffman
  - 2. Panduit
  - 3. Substitutions: According to Division 01 and Section 26 0000.
- B. Ladder rack / cable runway for use in telecommunication rooms and spaces.
- C. UL listed for Equipment grounding (straight and curved sections).
  - 1. Classified as suitable for an equipment grounding conductor.
  - 2. Provide required grounding jumper kits.
- D. Cross members 9" on center.
- E. Butt splice kits and junction-splice kits. Provide as needed to install as indicated on drawings.
- F. Black polyester powder coat.
- G. Width: as indicated on Drawings.
  - 1. Provide two radius drop kits minimum per rack and at each point where runway meets wall.
- H. Supports:
  - 1. Provide support racks as required to suspend runway from ceiling where span from wall to wall is longer than manufacturer's maximum dimension between supports. Center support kits only.
  - 2. Provide triangle support racks to support runway from wall where runway is routed along wall.
  - 3. Pro wall angle support where runway terminates at a wall.

### **2.05 FIRE BARRIER CAULK**

- A. Manufacturer:
  - 1. 3M Fire Barrier Caulk CP25.

2. Hilti.
3. Or equal.

## **2.06 FIRESTOP (FIRE-RATED CABLE PENETRATION)**

- A. Manufacturer: STI "EZ Path"
  1. Specified Technology Inc. – EZ Path.
  2. Hilti.
  3. Substitutions under provisions of Division 01 and Section – Electrical General Requirements.
- B. Description:
  1. Automatically adjusts to cable fill via intumescent insert material allowing for 0 to 100-percent visual fill of conductors.
  2. Includes both internal and external fire stopping.
  3. Cables penetrating through fire-rated floors or walls shall utilize fire-rated pathway devices capable of providing an F rating equal to the rating of the barrier in which the device is installed.
  4. The device shall be tested for smoke leakage (L rating).
  5. Wire devices shall be of a sufficient size to accommodate the quantity and size of electrical wires and data cables required and shall be suitable for use with new or existing cable installations.
- C. 1.5", 3", or 4" as required for project conditions or as noted on drawings.

## **2.07 FIRESTOP (PILLOWS)**

- A. Manufacturer:
  1. KBS "Sealbag".
  2. Hilti.
  3. Or equal.
- B. Description:
  1. Size as required for size of cable tray, quantity of conductors or as indicated on drawings whichever is larger.
  2. UL listed fire-rated assembly through fire-rated partitions, and walls.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Review location of installation to verify suitability of products installation. Verify environmental conditions are within manufacturer's suggested tolerances.

### **3.02 PREPARATION**

- A. Pre-installation meeting: Convene one week prior to commencing work of this section with General Contractor, Mechanical Contractor and all affected trades to coordinate route, clearances, etc.
- B. The contractor must coordinate the installation of the new pathways with other trades and project requirements. Revise locations and elevations from those indicated as required to suit field conditions and as approved by Owner representative,
- C. The contractor shall reference the related sections listed above to determine any additional requirements necessary to complete the project.
- D. Coordinate locations of required fire-rated construction with Architect.

### **3.03 INSTALLATION**

#### **A. General Requirements:**

1. The communications cabling pathways shall provide a route from the building's communications rooms to the communication outlet and provide a neat and workmanlike installation. Cables shall be routed parallel to or at right angles to building lines.
2. All products are to be installed per the manufacturer's instructions and procedures.
3. All pathways must remain accessible and useable after completion.

#### **B. Conduit Requirements:**

1. Minimum conduit size of 1".
2. The conduit will extend from the outlet box to the accessible ceiling space.
3. Conduit needs to run in the most direct route possible, usually parallel with building lines and in a workman like manner.
4. Junction / Pull boxes shall be required to limit the total bend radius in conduit to 180 degrees for communication systems cabling pathways. Install junction / pull boxes of appropriate size in conduit runs to limit the conduit to 180 degrees of total bend.
5. Bend limitation may be increased to 270 degrees by upsizing the conduit one trade size.
6. Terminate conduit entering telecommunications rooms from below within 4" of finished floor. Terminate conduit entering telecommunications rooms from above within 4" of ceiling or 12" above cable tray.

#### **C. Back box requirements:**

1. The communication system outlet box will be a 4"x4" square box fitted with a single gang mud ring unless noted otherwise.
2. Communication system outlets are not to be installed back to back.
3. Firestop the outlet box using a listed UL application in firewalls.

#### **D. Non-Continuous Cable Support Requirements:**

1. Install system Category compliant cable supports every 36" where cable tray is not used.
2. Install such that cabling is routed parallel to or at right angles to building lines.

#### **E. Fire Rate Cabling Penetrations**

1. Utilize UL listed removable/re-usable fire stopping assemblies where required.
2. Provide restorable fire stops inside and around conduits as recommended by UL1479 or ASTM E814 for all conduits penetrating fire-rated construction.

### **3.04 FIELD QUALITY CONTROL**

- A. Receive and unload cable tray in accordance with NEMA VE-2-2006 and the manufacturer's requirements.
- B. Store cable tray in accordance with NEMA VE-2-2006 and the manufacturer's requirements.

### **3.05 DOCUMENTATION**

- A. Provide certificate(s) according to requirements of specification section – Operation and Maintenance of Electrical Systems indicating that system bonding and grounding has been installed (include description of installation), spare capacity has been provided and that the entire installation is in accordance with these specifications.

### **END OF SECTION**



# SECTION 27 1000 - COMMUNICATIONS STRUCTURED CABLING SYSTEMS

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

- A. Communications equipment room fittings.
- B. Communications copper cabling.
- C. Communications coaxial cabling.
- D. Communications fiber optic cabling.
- E. Firestopping.
- F. Telecommunications Bonding Backbone.

### 1.02 DESCRIPTION OF WORK

- A. Work includes field survey of existing conditions, systems, equipment and tracing of existing circuits in order to determine scope of work
- B. Communications Backbone Cabling will include the following as shown on the Drawings or as Specified herein:
  - 1. Installation, testing, labeling and documentation of new communication backbone cable as specified herein and on the Drawings.
  - 2. The Contractor shall be responsible for: placement of cable, routing of cable through the communications cabling pathway system, termination of individual cables, labeling, testing and documentation of the work.
  - 3. The Contractor shall be responsible for termination of the cable at both ends.
  - 4. Backbone copper cabling.
  - 5. Backbone coaxial cabling.
  - 6. Backbone fiber optic cabling.
- C. Communications Horizontal Cabling will include the following as shown on the Drawings or as Specified herein:
  - 1. Installation, testing, labeling and documentation of new horizontal communication cable between the building's equipment rooms and outlets as specified herein and on the Drawings.
  - 2. The Contractor shall be responsible for: placement of cable, routing of cable through the communications cabling pathway system, termination of individual cables, labeling, testing and documentation of the work.
  - 3. The Contractor shall be responsible for termination of the cable at both ends.
  - 4. Horizontal copper cabling for voice and data communication systems.
  - 5. Horizontal coaxial cabling for Broadband and/or channelized distribution of television signal, including individual outlets.
- D. Communications Equipment Room Fittings will include the following as shown on the Drawings or as Specified herein:
  - 1. Cabinets.
  - 2. Racks.
  - 3. Enclosures.
  - 4. Termination blocks.
  - 5. Patch panels.

6. Cable management within telecommunication rooms.
7. Television distribution equipment.
8. Accessories.

### **1.03 RELATED DOCUMENTS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26, 27, and 28.
- B. See Section 27 0528 Pathways For Communications Cabling.

### **1.04 REFERENCES**

- A. NFPA 70 National Electrical Code 2014.
- B. ANSI/NEMA WD 6-2012: Wiring Devices – Dimensional Requirements.
- C. CEA-310-E Design requirements for Cabinets, Panels, Racks and Subracks, December 14, 2005
- D. IEC 60297-3-100 Basic Dimensions for front panels, subtracks, chassis, racks, and cabinets
- E. IEC 60297-3-101 Subtracks and associated plug-in units
- F. IEC 60297-3-102 Injector/Extractor Handle
- G. IEC 60297-3-103 Keying and alignment pin
- H. IEC 60297-3-104 Connector dependent interface dimensions of subtracks and plug in units
- I. IEC 60297-3-105 Dimensions and Design aspects for 1U chassis
- J. NECA/BICSI-568 Standard for Installing Commercial Building Telecommunications Cabling
- K. ANSI/TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises
- L. ANSI/TIA/EIA-568-C. 1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
- M. ANSI/TIA/EIA-568-C. 2, Commercial Building Telecommunications Cabling Standard (and all published addenda), Part 2: Balanced Twisted Pair Cabling Components.
- N. ANSI /TIA/EIA-568-C. 3, Optical Fiber Cabling Components Standard.
- O. ANSI /TIA/EIA-568-C. 4, Broadband Coaxial Cabling Components Standard.
- P. ANSI/TIA/EIA-569-C, Commercial Building Standard for Telecommunications Pathways and Spaces
- Q. ANSI /TIA/EIA-606-B, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- R. ANSI-J-STD-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications.
- S. UL 94, the Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing.
- T. UL 444 – Standard for Safety of Communications Cable
- U. UL 497 - Protectors for Paired-Conductor Communications Circuits.



V. UL 1666 – Standard for Safety of Flame Propagation Height

W. NFPA 262 – Flame Travel and Smoke of Wires and Cables

### **1.05 QUALITY ASSURANCE**

- A. Furnish Products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.
- B. Comply with the requirements of utility companies.
- C. Contractor Qualifications:
  - 1. A firm currently engaged and which has been continuously engaged for the past 5 years in the installation of applications of type required for this Project, and which can provide documentation of four completed projects similar in size and complexity to this project.
  - 2. The installing Contractor shall have a minimum one (1) Certified Installer trained to the latest industry standards to ensure the most reliable installation available.
  - 3. The Contractor shall have one (1) Certified BICSI level 2 Technician for every five (5) labors.
  - 4. The Contractor shall have written documentation stating the Level III Tester used on this project has been factory calibrated within the last 12 months.
  - 5. Contractor must provide documentation that they are manufacturer approved and certified for any wire system they propose to install.
  - 6. Contractor shall designate one person as the installation project manager / foreman who will take charge of overall project and be on-site while work is being performed and be present for project meetings when appropriate. Attendance at project meetings is mandatory unless absence is requested and agreed upon prior to meeting.
- D. Source Limitations: Obtain units of the same type of equipment through one source from a single manufacturer.
- E. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.
- F. Telecommunications Pathways and Spaces: Comply with ANSI/TIA-568-C.
- G. Coordination:
  - 1. Contractor shall coordinate with the Owner's network and computer equipment personnel for specific instructions before starting Work.
  - 2. Contractor shall coordinate with the General Contractor for location and type of blocking to be installed in the walls to support wall mounted equipment.
  - 3. Contractor shall coordinate location of electrical receptacles to be installed on raceways, racks or inside cabinets.

### **1.06 WARRANTY**

- A. Contractor shall provide a 1 year parts and labor warranty against defective workmanship and/or system component failure.
- B. UTP Horizontal Copper Cable: Contractor shall execute a minimum 20-year Applications Assurance Warranty for parts and labor to support stated applications from the connectivity Manufacturer.
  - 1. System Manufacturer(s) warrant that CAT 6 certified network installations will exceed the defined ANSI/TIA-568 C series industry specifications in force at the time of product purchase. Furthermore, the products that comprise the certified cabling system will meet or exceed the applicable performance specifications in effect at the time of manufacture

2. This warranty covers the copper and fiber optic permanent links of the network as defined by ANSI/TIA-568-C which includes the cable and connecting hardware. This warranty will be extended to include the entire channel provided that the applicable patch cords and equipment cords are utilized, and all products are installed within areas protected from outside elements.
3. Supplier will honor claims on this warranty for a minimum of 20-years (which is referred to as the "Warranty Period"). If system performance or material fails to meet the appropriate industry specification, the owner must notify Supplier, in writing, within ten 10 days of defect discovery date. If a warranty claim is determined by Supplier in its sole discretion to be valid, Supplier will, at its option, replace or repair the defective components of the permanent link. Supplier may reimburse the claimant for necessary and reasonable labor costs, provided prior approval is obtained from Supplier. The liability of Supplier for the above remedies shall not exceed \$300 per each network permanent link or end-user drop.
4. The electrical performance provided by the combination of the different components of the permanent link will be certified by Supplier to meet the applicable performance specifications in effect at the time of manufacture as long as each condition listed below is met
  - a. The network cabling infrastructure must be designed in accordance with ANSI/TIA-568 C Series Standards, and installed by a Manufacturer Certified or Supplier approved designers and installers. Supplier is not liable for design errors or improper construction.
  - b. Each permanent link or channel in the network must be field tested in accordance with the ANSI/TIA-568 C series industry standard in force at the time of purchase AND the installed permanent links and channels must have passed all applicable TIA and performance requirements. Minimum testing for copper systems includes Wire Map, Length, Attenuation, Near End Crosstalk, Far End Crosstalk, Return Loss, PS NEXT, ELFEXT, and PS ELFEXT.
  - c. Appropriate Warranty Application form must be properly completed and submitted to Supplier prior to initiating the installation. The Warranty Submittal Form must be submitted within 10 days of installation completion. Copies of all certification test reports must be submitted as part of the Warranty Submittal Form, and be kept on file by the registrant to be re-submitted when requested by Supplier. Data must be saved in raw data and summary formats. Submitting the data via online upload, e-mail or on disc are the preferred methods for providing test data
5. This minimum 20-year warranty will be void unless the system is maintained in accordance with industry standards and no changes are made after warranty issuance and acceptance date, unless Supplier grants written consent
6. A claim will be reviewed and held as valid only if all of the following are satisfied
  - a. Reported within ten (10) days of date of defect discovery.
  - b. ALL installation records are provided (original network installation design prints, test results, warranty submittal form).
  - c. Copies of all original receipts for materials and labor from the date of initial installation.
  - d. Supplier has full and open access to inspect and evaluate the installation site.
7. Supplier warrants to Buyer that at the time of delivery the goods sold hereunder will be free from defects in design, material, and manufacture and will conform substantially to the Supplier's applicable specifications as stated herein. Supplier's liability and Buyer's remedy under this warranty are strictly limited to the repair or replacement specified above

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

- A. Contractor shall ensure that materials delivery to work area shall be coordinated with construction site manager responsible for materials distribution to all trades.
- B. Contractor is responsible for all materials, tools and vehicles left on the job site.
- C. Contractor shall coordinate a disposal bin for the removal of all trash produced by the Contractor's associated personnel during the project

- D. Contractor shall ensure materials are stored in an environmental area where:
  - 1. Temperature does not exceed 120 degrees Fahrenheit nor below 32 degrees Fahrenheit.
  - 2. Humidity does not exceed 80 %.
  - 3. No direct exposure to sunlight.
- E. Cable shall be stored according to Manufacturer's recommendations as a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable will be stored off site at the Contractor's expense.
- F. Deliver equipment in individual shipping splits for ease of handling, mount on shipping skids and wrap for protection
- G. Inspect and report concealed damage to carrier within specified time.
- H. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation. Meet the requirements and recommendations of NFPA 70B and the Manufacturer. Location will be protected to prevent moisture from entering enclosures and material.
- I. Handle in accordance with NEMA and the Manufacturer's recommendations and instructions to avoid damaging equipment, installed devices and finish.
- J. The equipment will be kept upright at all times. When equipment has to be tilted for ease of passage through restricted areas during transportation, the Manufacturer will be required to brace the equipment suitably to insure that the tilting does not impair the functional integrity of the equipment.

#### **1.08 SUBMITTALS FOR REVIEW**

- A. Submit according to the requirements of Division 01 and Section – Electrical General Requirements.
- B. Provide manufacturer's data sheets for each product specified including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Provide documentation that Contractor Qualifications listed in paragraph 1.6 above are met including:
  - 1. Manufacturer approval / certificate
  - 2. Installer certificates.
  - 3. Name and credentials of project manager / foreman.
- D. Fire Stopping
  - 1. Shop Drawings:
    - a. Submit shop drawings showing each condition requiring penetration seals indicating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.
    - b. Submit a copy of UL illustration of each proposed system indicating Manufacturer approved modifications.
  - 2. Manufacturer's Data: Submit copies of Manufacturer's specifications, recommendations, installation instructions, and maintenance data for each type of material required. Include letter indicating that each material complies with the requirements and is recommended for the applications shown.
  - 3. Applicator's Qualification Statement: List past projects indicating required experience.

## 1.09 SUBMITTALS FOR INFORMATION

- A. Submit per the requirements of Division 1 and Section – Electrical General Requirements.
- B. Submit the following:

## 1.10 SUBMITTALS FOR CLOSEOUT

- A. Submit per the requirements of Division 1 and Section 26 0100.
- B. Operation and Maintenance Manuals include information noted in section Operation and Maintenance Manuals for Electrical Systems and the documentation required by Part 3.
- C. Submit Warranty documentation.

## PART 2 PRODUCTS

### 2.01 OUTSIDE PLANT FIBER OPTIC BACKBONE CABLE

- A. Manufacturers must comply with the requirements of this specification, including those listed below:
  - 1. Commscope
  - 2. Belden
  - 3. General
  - 4. Berk-Tek
  - 5. Substitutions according to provisions of Section – Electrical General Requirements.
- B. Cable Description:
  - 1. Single jacket, loose tube, gel-filled.
- C. Cable construction gel-filled (12 strands or less):
  - 1. Gel filled buffer tube and optical fibers.
  - 2. Water blocking tape.
  - 3. Overall strength member.
  - 4. Corrugated steel armor (provide where indicated / noted on drawings).
  - 5. Outer Jacket.
- D. Cable Construction gel-filled, single jacket (individually jacketed bundles for strand counts greater than 12)
  - 1. Central strength member.
  - 2. Gel filled buffer tubes with optical fibers.
  - 3. Water blocking tape.
  - 4. Overall strength member.
  - 5. Corrugated steel armor (provide where indicated / noted on drawings).
  - 6. Outer Jacket.
- E. Single Mode Description:
  - 1. Single-mode optical fiber
  - 2. Strand count as indicated on Drawings.
  - 3. ITU 652.D compliant.
  - 4. ISO/IEC 11801 nomenclature: OS2.
  - 5. Wavelength: 1310/1383/1550
  - 6. Max Attenuation (dB/km): 0.4 / 0.4 / 0.3
  - 7. Serial 1 gigabit Ethernet distance (m): 5000 / - / -

8. Serial 10 gigabit Ethernet distance (m): 10,000 / - / 40,000.

F. Multi-mode Description.

1. 50/125 multi-mode, OM4.
2. Strand count as noted on the Drawings.
3. Color Code: TIA/EIA-598-A, Optical Fiber Cable Color Coding.
4. 900 micron fibers.
5. Attenuation:
  - a. 3.5dB/km @ 850 nm;
  - b. 1.0 dB/km @ 1300 nm
6. Minimum Bandwidth:
  - a. Overfill Launch: 1500 MHz/km @ 850 nm / 500 MHz/km @ 1300 nm
  - b. Laser 4700 MHz/km @ 850 nm (using 3.0 DB cable attenuation and 0.7 dB connector allocation).
7. Gigabit Ethernet Link Length: 1000m @ 850 nm.
8. 10 Gigabit Ethernet Support Distance: 550 m @ 850 nm.

## 2.02 UTP HORIZONTAL COPPER CABLING

A. Manufacturer:

1. Belden
2. General
3. Commscope
4. Berk-Tek / Leviton
5. Substitutions according to provisions of Section – Electrical General Requirements.

B. Performance Requirement.

1. Horizontal four pair Category 6 copper cabling system shall be capable of supporting 1000 Base-T applications for a total distance of 100 meters with equipment cords. System shall provide “future proof” channel performance and guaranteed margins as noted in this document and is guaranteed to exceed ANSI/TIA-568-C.2 Category 6 specifications for Insertion Loss, NEXT, PSNEXT, ELFEXT, PSELFEXT and Return Loss to 250 MHz.
2. The System is Guaranteed 3.5 dB PSACR headroom at 250 MHz

C. Product: Construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.

D. UTP Standard Plenum, Category 6.

E. Jacket Color:

1. Blue for data.
2. White for voice.
3. Yellow for video surveillance, access control, intrusion detection.
4. Red for fire alarm.
5. Pink for Audio / Video.

F. Telecommunications Jacks.

1. The communication jack shall be POE (Power over Ethernet) verified and tested to meet 802.3af cable standards, including third party component verification. 100% manufacturer tested.
2. Modular type RJ45 that snap into the four-port frame.
3. 8 position/8 conductor modular jack, with flush mount, rear loading, snap in fitting.

4. Jack shall be constructed with a punch type down termination method including a dust cover cap.
5. Jack shall be labeled with universal wiring diagrams 568A and 568B.
6. Jacks shall be available in multiple standard colors with optional color icon capabilities.
7. Category 6 jack shall meet Category 6 component performance according to ANSI/TIA/EIA-568-C.2 requirements.

### **2.03 FACEPLATES:**

- A. Accept a minimum of four (4) modular jacks.
- B. Provide blank filler plates where extra ports are not used.
- C. Color to match adjacent wiring devices.
- D. Material shall match plates specified in 262726.
- E. Similar to Panduit Classic Style.
- F. Panduit Mini-Com Executive Style.

### **2.04 PATCH PANEL – MODULAR STYLE**

- A. Manufacturers:
  1. Commscope
  2. Panduit
  3. Ortronics
  4. Hubbell
  5. Leviton
  6. Substitutions according to provisions of Section – Electrical General Requirements
- B. Snap in style fits in standard 19" equipment rack.
- C. Accepts jacks provided as specified herein.
- D. Category 5e, 6, or 6A compliant as required to match cable and jacks specified herein.
- E. Permanent label strip.
- F. Die-cast aluminum construction.
- G. Flat construction, 24 or 48 port, 1 or 2 RU.
- H. Panels shall accept a clip-on rear cable management support bar to provide cable strain relief

### **2.05 RACKS**

- A. Manufacturer:
  1. Hoffman
  2. Panduit
  3. Ortronics
  4. Chatsworth.
  5. Or Equal.
- B. General (common to all racks)

1. Cabinet shall have dedicated bonding points for proper grounding according to ANSI-J-STD-607B. Furnish and install ground terminal block/lug for each rack and #6 ground wire to room ground bus bar.
2. Universal hole pattern on the front and rear flanges, and threaded mounting holes on both sides of rack assembly for management.
3. Racks will be black in color.
4. Racks will have 12-24 threaded equipment mounting holes
5. Horizontal cable support bar on rear of each patch panel/cross connect block panel to support hook and loop (Velcro) strain reliefs. Cables will not rely on terminations for cable support.
6. Hook and loop (Velcro) cable strain relief system on rear of rack to support horizontal and backbone cables.
7. All hardware, supplementary steel, channel and supports as required properly assembling the rack and supporting it to the building structure.
8. All equipment racks and their hardware will match in appearance and will be provided by a single manufacturer.
9. Furnish and install horizontal wire management units, quantity and type as indicated on the drawings.

C. Floor rack

1. Structural aluminum construction
2. Two 3-inch wide vertical rail channels
3. Two-piece angle base (front and rear).
4. Two top angle frame members.
5. Hook and loop (Velcro) horizontal and vertical cable management on front of rack for dressing patch cable and cross connect wiring.
6. Hook and loop (Velcro) cable management system independent of cable management to properly dress the electronic equipment power cords through the rack maintaining as much clearances between the two as possible.
7. Furnish and install vertical wire management channels on both side of racks.

D. Hinged wall mount bracket: 19" wide x 6" deep x height as required for equipment, black powder coat finish, grounding kit

E. Wall mounted swing gate rack:

1. Open wall mount design lets the racks swing out.
2. 150 lb. weight capacity when mounted on block or concrete wall, or when used with optional SGR-MR wall strengthening mounting rails.
3. 18" deep
4. 25" deep
5. 20" wide
6. Single sided 12/24 tapped holes, 5/8 inch, 5/8 inch, 1/2 inch EIA Standard hole pattern, pre-threaded holes.
7. Furnish and install vertical wire management channels on both sides of rack, as recommended by rack manufacturer

## 2.06 CABINETS

A. Manufacturer:

1. Ortronics
2. Chatsworth
3. Hoffman
4. Or Equal.

B. Performance and Design Requirements:

1. Cabinets shall be UL LISTED 1863.
2. Cabinet shall have dedicated bonding points for proper grounding according to ANSI-J-STD-607A.

C. Cabinets: Size and components as scheduled on drawings:

1. Product: Wall Mount Design shall be a three piece modular swivel-type, 14 gage (1.897 mm) steel, reinforced welded enclosure with a removable front door, and removable rear section. Each basic unit shall consist of: (1) rear section, (1) center section with locks, (1) front door, (1) top plate (1) bottom plate, (2) 19 inches (483 mm) panel-mounting rails, and (2) hinge pins with cotter pins.
2. Product: Floor Mount Design shall be a three piece modular swivel-type, 14 gage (1.897 mm) steel, reinforced welded enclosure with a removable front door, and removable rear section with mobile base for floor mounting. Each unit shall consist of: (1) rear section, (1) center section with locks, (1) front door, (1) top plate (1) bottom plate, (2) 19 inches (483 mm) panel-mounting rails, and (2) hinge pins with cotter pins.

## 2.07 CABLE MANAGEMENT

A. Manufacturer:

1. Hoffman
2. Panduit
3. Ortronics
4. Leviton
5. Or Equal.

B. Vertical Cable Management:

1. Supply Full Height Vertical Cable Management on each side of rack, front and rear 6" deep.

C. Horizontal Cable Management:

1. Supply Horizontal Cable Management between each patch panel and Ethernet Switch.
2. Type:
  - a. Horizontal and vertical distribution rings
  - b. Plastic construction panel and rings
  - c. 2" height x 2.5" deep, 19" wide
  - d. 1 rack unit
  - e. Rack or cabinet mounted
3. Type:
  - a. Horizontal distribution rings
  - b. Plastic construction panel and rings
  - c. 3" height x 4" deep x 19" wide
  - d. 2 rack units
  - e. Rack or cabinet mounted

D. Cable Management Rings:

1. D-Ring for use at termination boards.
2. Size as required for quantity of cables
3. Black, flexible, one-piece polycarbonate construction.

## 2.08 PATCH CORDS

A. Manufacturer:



1. Commscope
2. Quicktron
3. Panduit
4. Ortronics
5. General
6. Substitutions according to provisions of Section – Electrical General Requirements.

B. Type:

1. Connectors at both ends (RJ45, or eight contact male 110 connector)
2. 3', 5', 7', 9', 15' length, coordinate length with telecommunication room layout.
3. Category 6, 4-pair, #24 gauge solid copper

## **2.09 ACCESSORIES**

- A. The Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify the exact location prior to bid of all items that may be indicated and determine exact location of all electrical items that are not indicated on the Drawings.
- B. Do not install equipment and materials that have not been reviewed by the Architect. Equipment and materials which are installed without the Architect's review or without complying to comments issued with the review will be removed from the project when so instructed by the Architect. No payment will be made for unapproved or removal if it is ordered removed. The Installer will be responsible for any ancillary costs incurred because of its removal and the installation of the correct equipment and materials.
- C. Refer to all Drawings associated with the project, prior to the installation or roughing-in of the electrical outlets, conduit and equipment, to determine the exact location of all outlets
- D. Verify that interior of building has been protected from weather.
- E. Verify that mechanical work likely to damage wire and cable has been completed.
- F. Verify that raceway installation is complete and supported.

### **3.02 PREPARATION**

- A. Equipment and systems will not be installed without first coordinating the location and installation of equipment and systems with the General Contractor and all other Trades.
- B. Material installed or work performed in violation of above requirements will be re-adjusted and corrected by the Installer without charge
- C. Obtain and review detailed information on installation requirements from the Manufacturers of all equipment to be furnished, installed or provided. At the start of construction, check all Contract Documents include all Drawings and all Sections of the specifications for equipment requiring electrical connections and service and verify electrical characteristics of equipment prior to roughing in.
- D. Completely and thoroughly swab raceway before installing wire.

- E. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and housing when so directed by service provider.
- F. Coordinate layout and installation of communication equipment.
- G. The contractor shall not be responsible for making the cross connect between the indoor cable termination and the OSP cable field, unless otherwise instructed.
- H. Contractor shall coordinate all cable pathways on site with other trades before construction.

### **3.03 GENERAL REQUIREMENTS FOR STRUCTURED CABLING SYSTEMS**

- A. All cables shall be installed to suggested manufactures instructions. Follow bend radius and pulling tension guide lines.
- B. All cable and associated hardware shall be placed so as to make efficient use of available space in coordination with other uses. All cable and associated hardware shall be placed so as to not impair the use or capacity of other building systems, equipment, or hardware placed by others (or existing).
- C. Cable Supports
  - 1. Tie wraps for horizontal cables will be secured with minimum required compression in order to secure the cables properly without impeding the signal transmission rating (geometry) of the cable. Hook and loop (Velcro) cable wraps may be used in lieu of cable ties for copper cables only.
- D. Labeling and Identification: Label per Section - Identification for Electrical Systems and the following:
  - 1. All communications equipment racks, cabinets, backboards and other termination hardware shall be labeled at the top left hand corner of each piece of equipment. With a minimum 3/4" high identification label, identifying the room and rack location numbering system.
  - 2. All communication copper and fiber patch panels shall be labeled with a minimum 3/8" high identification label identifying panels and sequential port numbering system.
  - 3. All face plates locations shall be labeled with a minimum 3/16" high label indicating the room rack, patch panel and port number.
  - 4. No hand written labeling will be allowed.
  - 5. The chosen alphanumeric labeling system shall be approved by Owner prior to any permit labeling system shall be installed.
  - 6. IDC style connecting hardware shall be color coded per the code identified the BICSI TDMM.
- E. Separation from EMI sources:
  - 1. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment will 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.
  - 2. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment will 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.
  - 3. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures will 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.
  - 4. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
  - 5. Separation between Communications Cables and Fluorescent or LED Fixtures: A minimum of 5 inches.
- F. Cable Protection
- 1. Provide bushings in all metal studs and the like where cables will pass through. Bushings will be of two (2)-piece construction with one piece inserted through the opening and the second piece locking it into place. Single piece bushings with locking tabs or friction fit are specifically prohibited.
  - 2. Cables to be installed in existing enclosed open bays or furred spaces where conduit stubs are not provided, will be protected from chafing or any damage. The Installer will verify that the warranty will not be violated before installing any cabling in these locations.
  - 3. Provide cutting, coring, sleeves and bushings and seal as required at all penetrations.
  - 4. Cables damaged during installation will not be repaired. They will be completely replaced with new cable at no cost to the Owner.

### **3.04 FIRESTOPPING**

- A. Work, in general, includes furnishing and installing fire and smoke barrier penetration seals for openings in floor, walls, and other elements of construction.
- B. Comply with requirements in Division 07 Section "Penetration Firestopping."
- C. Comply with TIA/EIA-569-C, Annex A, "Firestopping."
- D. Comply with BICSI TDMM, "Firestopping Systems" Article.
- E. Applicator Qualifications: Two years' experience installing UL classified firestopping.
- F. Performance of materials will have been tested to provide fire rating equal to that of the construction.
- G. Existing Project Conditions:
  - 1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
  - 2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.
- H. Environmental Requirements:
  - 1. Furnish adequate ventilation if using solvent.
  - 2. Furnish forced air ventilation during installation if required by Manufacturer.
  - 3. Keep flammable materials away from sparks or flame.
  - 4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
- I. Warranties: Submit copies of written warranty, minimum of one year, agreeing to repair or replace joint sealers which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted Manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period will be one year from date of substantial completion.
- J. Acceptable Manufacturers: Subject to compliance with requirements, provide products of Nelson Fire Protection Products or Engineers approved equal.

- K. Materials:
  - 1. Provide materials classified by UL to provide Fire Barrier equal to time rating of construction being penetrated.
  - 2. Provide asbestos free materials that comply with applicable codes and have been tested in accordance with UL 1479 or ASTM E-814.
- L. Preparation: Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.
- M. Installation:
  - 1. Install penetration seal materials in accordance with printed instructions of the UL Building Materials Directory and in accordance with Manufacturer's instructions.
  - 2. Seal holes or voids made by penetration to ensure an effective smoke barrier.
  - 3. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install firestopping materials capable of supporting same loading as floor.
  - 4. Protect materials from damage on surfaces subject to traffic.
- N. Field Quality Control:
  - 1. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.
  - 2. Keep areas of work accessible until inspection by applicable code authorities.
  - 3. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.
- O. Adjusting and Cleaning:
  - 1. Clean up spills of liquid components.
  - 2. Neatly cut and trim materials as required.
  - 3. Remove equipment, materials and debris, leaving area in undamaged clean condition.

### **3.05 SEALING OF PENETRATIONS AND OPENINGS**

- A. All firestop systems will be installed in accordance with the Manufacturer's recommendations and will be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.
- B. Provide a seal around raceways or cables penetrating full height walls (slab to slab), floors or ventilation or air handling ducts so that the spread of fire or products of combustion will not be substantially increased.
- C. Penetrations through fire-resistant-rated walls, partitions, floors or ceilings will be fire stopped using approved methods and NRTL listed products to maintain the fire resistance rating.
- D. Installation restrictions of the listing agencies will be strictly adhered to e.g. 24 inch minimum horizontal separation between boxes on opposite sides of the wall, maximum square inch opening in wall.
- E. Fire stopping in sleeves or in areas having small openings that may require the addition or modification of installed cables or raceways will be soft, pliable, non-hardening fire stop putty. Putty will be water resistant and intumescent.
- F. Fire stopping in locations not likely to require frequent modification will be NRTL listed putty or caulk to meet the required fire resistance rating.
- G. Box penetrations into a fire rated wall or shaft will have a fire-stopping pad installed on the back of the box.

- H. Fire stopping materials will be NRTL listed to UL 1479 (ASTM E814). Installation methods will conform to a UL fire stopping system. Submit specifications and installation drawings for the type of material to be used. Fire stopping materials will be as manufactured by 3M, International Protective Coatings Corp., Specified Technologies, Inc., Carborundum Company, RayChem, Nelson Fire Stop or approved equal.

### **3.06 TELECOMMUNICATIONS BONDING BACKBONE (TBB)**

- A. Comply with ANSI/TIA-607 B.
- B. TBB placed in ferrous metallic conduit that exceeds 1m(3 ft) in length, will be bonded to each end of the conduit with a conductor sized as a NO. 6AWG, minimum.
- C. The TBB conductor will be bonded to the service equipment (power) ground.
- D. All Telecommunications Bonding Backbone (TBB) Cables will be insulated and installed in conduit between manholes, telecommunications closets, building steel frame and building electrical grounding system
- E. TBB cables will interconnect all Telecommunications Grounding Busbars (TGB) with the Telecommunications Main Grounding Busbar (TMGB). The TBB will originate at the TMGB and extend throughout the building and connects to all the TGB's in telecommunications closets and equipment rooms. See details on Drawings.
- F. The TBB will be installed without splices, where practicable. If splices are necessary they will be minimum in number accessible and located in telecommunications spaces. Joined segments will be connected using irreversible compression-type connectors, exothermic welding or equivalent.
- G. Unless noted otherwise, The TBB will be No. 3/0 AWG between TMGB and TGB's. The TBB from one TGB to another TGB will be No. 6 AWG. The TBB from TGB to the panel board in the same telecommunications space will be No. 6 AWG. All TBB connections to the TGB will utilize listed 2-hole compression connectors.
- H. Exothermic welds will be used to connect TBB from TMGB or TGB and building steel frame. All other connections will use 2-hole compression connectors.

### **3.07 HORIZONTAL COPPER CABLE INSTALLATION**

- A. Common work for communication systems shall be installed in a neat and workman like manner. The NEIS Standard Practices for Good Workmanship in Electrical Contracting NECA 1-2006 and BICSI/TIA/EIA Telecommunications Cabling Installation Manual latest edition is hereby adopted to define such workmanship and the installation of communications equipment room fitting.
- B. Each jack shall be cabled directly from the telecommunication room to the remote outlet location via the communications cabling pathway (no splices).
- C. Wiring Method: Install horizontal cabling in raceways except within racks, D-rings, on plywood backboard, cabinets, and except in accessible ceiling spaces where non-continuous cable support system may be used. Conceal raceway and cables except in unfinished spaces.
- D. 10 ft. length X 12" diameter service loop shall be provided at work station location, above accessible ceiling.
- E. Cables shall be bundled in like jacked color groups and general directions of cable paths.
- F. Utilize D-ring and color-coded flexible straps at termination board for vertical and horizontal cable management.
- G. Maximum horizontal cabling length: 295 feet.

- H. The cable's manufacturer's minimum bend radius and maximum pulling tension shall not be exceeded.
- I. Wire all jacks according to ANSI/TIA/EIA T568-B configuration.
  - 1. The UTP cabling systems will have TIA/EIA T568B pin/pair termination assignment. All conductors provided will be properly and consistently terminated at both ends throughout the entire systems. Maintain proper untwist of pairs and removal of jacket per TIA and BICSI
- J. Horizontal cabling shall be terminated such that wire pair twists are maintained as closely as possible to the point of mechanical termination. (No greater than 0.5" for category 5e or 6 cables.)
- K. Horizontal wiring within equipment rooms and closets:
  - 1. Bundle, lace, and train cables within cable tray / racks / D-rings.
  - 2. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radius.
  - 3. Provide and use wiring management.
  - 4. Cable paths shall be installed in vertical and horizontal right angle configurations.
- L. Terminations:
  - 1. Voice: Patch Panels.
  - 2. Data: Patch Panels.
- M. Provide cross-connect cable / patch cords for the voice system for Owner provided telephone equipment.
- N. Provide cross-connect cable / patch cord for the data system for Owner provided data equipment.
- O. Securely mount equipment racks / cabinets per manufacturer's recommendations.
- P. Provide 25% spare capacity at copper cross-connect blocks, patch panels, and cable management system for future expansion.

### **3.08 FACEPLATES INSTALLATION**

- A. All face plates shall be installed in a vertically plumb position, if this is not possible, notify other trades for corrective action.
- B. Excess cable service loops shall not be stored in back box, cables should be pulled back into ceiling space.
- C. All un-used plate opening shall be filled with blanks.
- D. All face plates locations shall be labeled according to specification section Identification for Electrical Systems.

### **3.09 TELECOMMUNICATION EQUIPMENT ROOM INSTALLATION**

- A. 25ft Service Loops for all backbone cables / cable types shall be provided at each communication room or closet. The cable shall be neatly bundled and stored on wall or in ceiling for future expansion.
- B. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools
- C. Equipment Racks and Panels
  - 1. Securely mount equipment cabinet and racks to the building structure. Proper supports such as 3/8" lag screws and expansion anchors will be used. Proper quantity of supports will be utilized. Dry wall screws and other types of supports not specifically approved to support equipment are specifically prohibited. Submit mounting supports for approval before installation.

2. Equipment cabinet mounted on or against walls will have 3-foot clearance in front of deepest component.
  3. Patch Panels: Mount patch panels into the cabinet/rack in top-to-bottom fashion with the first patch panel (Fiber) mounted at the top of the "Active" equipment rack. Uniquely label each patch panel according to the numbering convention outlined in the SECTION on labeling. Each port will also have color-coded identifiers. Refer to details on the Drawings.
  4. Cable Management: Secure the cable bundle(s) to the rack strain relief and cable management behind the patch panels and cross connect block panels. Install horizontal cable management panels and brackets for routing and management of patch cables. Maintain TIA/EIA and BICSI standards on bundling, supporting and bend radii.
  5. Surge Protected Outlet Strips: Mount surge protected outlet strips per Manufacturer's directions. Refer to details on the Drawings for mounting location.
- D. Bonding and Grounding:
1. See specification Section 26 0526.
  2. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) 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.
  3. Cabinet and racks shall have dedicated bonding connection for proper grounding according to ANSI-J-STD-607-B.
  4. Bond metallic equipment to the grounding bus bar, using not smaller than No. 10 AWG equipment grounding conductor.
- E. Cable shall be terminated on the same category rated blocks or higher than the installed cable.
- F. A trough Style cable management system for cross connecting blocks shall be provided.
- G. The cross connect field shall be designed for 25% growth, for future changes.
- H. All communications equipment racks, cabinets, backboards and other termination hardware shall be labeled at the top left hand corner of each piece of equipment. With a minimum ¾" high identification label, identifying the room and rack location numbering system.
- I. All communication copper and fiber patch panels shall be labeled with a minimum 3/8" high identification label identifying panels and sequential port numbering system.

### **3.10 BACKBONE CABLE INSTALLATION**

- A. All cables running outside the building shall be rated for outside plant installation.
- B. Unless noted otherwise backbone cables shall be installed conduit pathways. All cables not in raceways shall be riser or plenum rated.
- C. Backbone cables shall be grouped separately from horizontal distribution cables. Cable for other systems shall be grouped separately from cables for telephone and data
- D. Unless noted, all interior wiring shall be installed in raceways
- E. Each cable run between terminating locations shall be one continuous cable (no splices or connections). No mid span fiber spicing shall be permitted on backbone cable runs.
- F. All wires shall be marked at all junction boxes, pull boxes, cabinets, boxes and terminations.

- G. The Contractor shall install cable in such a manner as to prevent stretching, kinking or sharp bends. Cable damaged during installation or not passing required testing shall be removed and replaced at no additional cost to Owner
- H. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over tightened bindings, loosely twisted and over twisted pairs at terminations, and too much jacket removed
- I. Minimum bend radius and maximum pulling tension for all cables shall be maintained during and after installation. Install cable in accordance with manufacturer's ratings and instructions
- J. The armoring of cable shall be maintained into the fiber termination cabinet and used as the cable restraint. The armor shall be also be properly grounded.
- K. Installation of Backbone cable within the ER:
  - 1. The cable shall be secured to the ER wall or other specified location using Velcro cable wrap brackets.
  - 2. Cables shall be neatly bundled with hook and loop type fasteners. Nylon tire wraps are not acceptable. Cables must be neatly bundled in the telecommunications spaces and at the cable service loop
  - 3. The end of the cable, exclusive of the coil of slack, shall be routed to the splice housing mounted within the equipment rack for furcation and termination.
  - 4. Leave a maximum of 6 feet of buffer tube in the fiber optic enclosures. Secure the cable to the wall or equipment frame using Velcro cable wraps.
  - 5. Cables shall be routed as close as possible to the ceiling, floor, or corners to insure that adequate wall or backboard space is available for current and future equipment and for cable terminations. Cables shall not be tie-wrapped to existing electrical conduit or other equipment. Minimum bend radius shall be observed
  - 6. Dress and attach cables to the backboard along the shortest possible route run square (horizontal and vertical) to the backboard. Bundle similarly routed cables together and attach by means of clamps or distribution rings. Cable dress and attachment shall minimize obstruction to future installations of equipment, backboard, or other cables
- L. Cable service loops shall be provided at both ends of backbone cable runs:
  - 1. At the telecommunications room, provide a minimum 8 foot service loop stored in a figure eight pattern in the cable tray above the racks/cabinets.
  - 2. At the telecommunications room, provide sufficient slack to properly dress and terminate cables at the racks and cabinets
    - a. Provide sufficient slack so that swing gate type racks and cabinets can open fully
    - b. Provide sufficient slack so that cables do not catch or bind at swing gate type rack or cabinet hinge and the cables do not pull taught across the hinge or edge
  - 3. A minimum 25 foot service loop shall be maintained at each building entrance and exit
- M. A break-away link shall be used for installation of cables with a cable-puller or winch. The break-away link shall be designed to separate at or below the recommended maximum tension of the cable being installed
- N. Any damage to Owner's existing cabling or existing cable owned by others, caused as a result of work performed under this scope, shall be brought to the Owner's attention and repaired or replaced within 48 hours.
- O. Contractor shall use only cable lubricants recommended by the manufacturer for use with the specific cable construction.



P. Should a cable become kinked, skinned or stretched during installation, the cable shall be removed and replaced at no additional cost to the Owner. Splicing at points other than those specified will not be acceptable.

Q. Outside Plant Cable

1. Cable service loops shall be included in each manhole to allow for proper cable dressing, splicing the cable outside the manhole in a controlled space and for repairing damaged cable
2. Install sufficient cable slack to remove cable from the manhole for splicing in a splice van or tent
3. In addition to the cable slack required for proper termination/splicing in a splice enclosure, the Contractor shall install sufficient cable slack to form at least one loop of cable along the inner perimeter of the manhole
4. Where no cable splice is planned for a manhole, the contractor shall leave sufficient slack to form at least two loops of cable along the inner perimeter of the manhole
5. Cable service loop lengths shall be adjusted based on manhole size, manhole depth and existing conditions
6. Cables slack shall be securely fastened to all four walls of the manhole. Furnish and install bracket arms for securing and mounting of all cables where built-in racking exists
7. If racking is not furnished in a manhole, furnish and install a cable sling of weather, water, oil and solvent resistant material to support the cable(s) on those walls without built in racking.
8. Cable splice enclosures shall be security fastened to mounting arm brackets attached to manhole racking. Furnish and install racking and mounting arm brackets to support splice cases. Cable splice enclosures shall be attached to at least two racks in the manhole
9. All cables shall be secured to bracket arms using cable ties and straps resistant to weather, water, oil, fuel and solvents. Plastic or stainless steel ties/straps rated for this application shall be acceptable for use
10. All cable dressing in manholes shall be performed so that the minimum bend radius of cables is not exceeded
11. All cable splice enclosures shall be mounted either on the long wall of the manhole or on the wall parallel with the main cable run entry and exit conduits.
12. Wherever possible in existing manholes, and as a standard for manholes furnished and installed under this or an associated project, optical cable splice enclosures shall be mounted on one long wall (or parallel wall as previously defined) and copper cable splice enclosures shall be mounted on the opposite wall.
13. Wherever possible, large pair count copper cable enclosures shall be mounted at the vertical mid-line of the manhole and fiber cable splice enclosures shall be mounted at or above the vertical mid-line.
14. All cables shall be spliced in splice enclosures as specified herein.
  - a. Furnish and install the maximum slack in each enclosure as recommended by the cable, splice system and enclosure manufacturer.
  - b. Furnish and install all splice trays, splice holders, splice tray holders, mounting brackets, frames, grounding and other ancillary hardware and materials as required by the cable manufacturer, splice system manufacturer, splice enclosure manufacturer and standard industry practices.
  - c. Only technicians trained in the proper assembly of enclosures, splices and splicing procedures shall be permitted to splice cables.

R. Furcation of Fiber Optic Cable: Prior to termination, fiber optic cable strands will be furcated (fanned out) using the specified furcation kits and using the procedure specified by the manufacturer.

S. Termination of Fiber Optic Cable

1. Where specified, the Contractor shall terminate the individual fiber strands with connectors per the manufacturer's specifications.

2. Upon final testing, mated-pair connector attenuation shall not exceed 0.75 dB. Connectors which exceed this level of attenuation shall be cut off and fibers re-terminated by the Contractor.
3. Terminated fibers shall be installed within a fiber termination panel mounted within an equipment rack, as specified on the Drawings.

### **3.11 IDENTIFICATION**

- A. See Section - Identification for Electrical Systems for additional product information.
- B. All components of the structured cabling system shall be labeled including but not limited to cables, connecting blocks, patch panels, racks, cabinets, and outlet plates.
- C. Identification conventions shall match the Owner's current labeling convention. If there is no current labeling convention or the current convention is no longer adequate the following shall be used.
- D. Cables shall be identified at each end. Same designation shall be used at both ends.
  1. A basic labeling convention of sequential numbering shall be used.
  2. Provide wire markers as follows for horizontal UTP copper cabling in the following format – match owner's method.
- E. Outlet faceplates shall be identified.
  1. Room number – faceplate sequence within room (clockwise from north) – X# where X indicates use (D for data, V for voice, W for wi-fi, C for coax CATV) and # is the jack sequence (clockwise from top right).
- F. Racks shall be identified as indicated on Drawings. If not designation are made on the Drawings submit an RFI with suggested naming convention.
- G. Rack mounted termination equipment (patch panels, IDC connectors, fiber enclosures, etc.) shall be identified by color (as noted in BICSI TDMM) and by row within termination field, and by position within a particular terminal block or patch panel, etc.

### **3.12 GENERAL QUALITY CONTROL**

- 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.
- C. 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.
- D. Protect installed products until completion of project.
- E. Touch-up, repair damaged products before Substantial Completion.
- F. The engineer reserves the right to a 10% random retest of horizontal station cables at no additional cost to the Owner.
- G. Failure to meet industry test standards will require the contractor replace non-performing components at their own exposure.
- H. After installation, equipment will be protected to prevent damage during the construction period. Openings in conduits and boxes will be closed to prevent the entrance of foreign materials.

### 3.13 HORIZONTAL COPPER CABLING FIELD QUALITY CONTROL

- A. Communications horizontal copper cabling shall be 100% tested.
- B. Field Testing Equipment: Submit during shop drawing review on the testing equipment to be utilized on this project. The installer shall test all cables installed under this Section
  - 1. The cable tester shall have a wide variety of preprogrammed cable types as an integral part of its testing system and have the ability to test cables less than 6 feet (6ft.) from the test point.
  - 2. Testing shall be accomplished using level III or higher field tester that is loaded with the most current version of test software by the manufacturer of the test equipment.
  - 3. Provide factory calibration report of field test equipment.
- C. Testing Procedure:
  - 1. Testing shall conform to ANSI/TIA-568-C.0 standard.
  - 2. Testing will be to the Permanent Link Test Parameters.
  - 3. Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct grounded and reversed pairs. Examine open and shorted pairs to determine if problem is caused by improper termination. If termination is proper, tag bad pairs at both ends and note on termination sheets.
  - 4. Test each UTP cable and passive components. Provide certification that entire installation of UTP cabling, equipment and jacks are NRTL certified meeting or exceeding a minimum of category performance specified on all four pairs of conductors.
  - 5. Tests shall be based on each pair of conductors and not the aggregate multiple pair results.
  - 6. Test all installed cable segments end-to-end, from the telecommunications room horizontal patch panel/cross connect block panel to each work area outlet and from each telecommunications room backbone patch panel/cross-connect block panel to respective main cross connect, and from the work area outlet to the main cross-connect (through patch cables or cross- connect wiring) with a Signal Injector, Graphical Link Testing Meter and Time Domain Reflectometer (TDR) for compliance to latest TIA performance requirements, as well as NEXT, ELFEXT, structural return loss, alternating power sum, opens, shorts, continuity, cable length, and characteristic impedance.
  - 7. Provide report indicating failures and what actions were taken to ensure a passing horizontal cable and its terminations. Any cable failing the certification test (Fail, Fail\* or, Pass\*) must have remedial work done to provide a full pass test result; Remediation may include retermination or replacement of the cable, which fails. No cables passing within tolerance only (Conditional Pass\*) will be accepted.
- D. Test results:
  - 1. The test results information for each link shall be recorded in the memory of the field tester upon completion of the test. The tester shall be capable of storing test data in either internal or external memory. The external media used shall be left to the discretion of the user.
  - 2. Test results saved by the tester shall be transferred into a Windows based database utility that allows for maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered as well as any printed reports generated from the software application.
  - 3. Optional formats of data reporting are: comma separated variable (.csv), Portable Document File (.pdf) or compatible, plain text (.txt), or hypertext markup language (.html/.htm).
  - 4. Test Results shall include the following:
    - a. Applicable Telecommunications Room number
    - b. Circuit I.D. number with corresponding jack identifier
    - c. Wire Map – shall include the following:
      - i) Continuity to the remote end

- ii) Shorts between any two or more conductors
  - iii) Crossed pairs
  - iv) Reversed pairs
  - v) Split pairs
  - vi) Any other miswiring
- d. Length
  - e. Insertion Loss
  - f. Near-end Crosstalk (NEXT) Loss
  - g. PS-NEXT (Power Sum Near End Cross Talk)
  - h. ELFEXT (Equal Level Far End Cross Talk)
  - i. PS-ELFEXT (Power Sum Equal Level Far End Cross Talk)
  - j. Propagation Delay
  - k. Delay Skew
  - l. Return loss

### **3.14 BACKBONE CABLE FIELD QUALITY CONTROL**

- A. On completion of the cable installation and termination the cable shall be tested before put into use.
- B. Category 3 Copper Cable Testing
  - 1. Cable tester will be NRTL certified for EIA/TIA TSB95.
  - 2. Test each pair and shield of each cable for opens, shorts, grounds, and pair reversal. Correct grounded and reversed pairs. Examine open and shorted pairs to determine if problem is caused by improper termination. If termination is proper, tag bad pairs at both ends and note on termination sheets
  - 3. Test each UTP cable and passive components. Provide certification that entire installation of UTP cabling, equipment and jacks are NRTL certified meeting or exceeding a minimum of category performance specified on all four pairs of conductors
  - 4. Tests will be based on each pair of conductors and not the aggregate multiple pair results
  - 5. Test all installed cable segments end-to-end, from each telecommunications room backbone patch panel/cross-connect block panel to respective main cross connect.
  - 6. Provide report indicating failures and what actions were taken to ensure a passing horizontal cable and its terminations. Any cable failing the certification test (Fail, Fail\* or, Pass\*) must have remedial work done to provide a full pass test result; Remediation may include retermination or replacement of the cable, which fails. No cables passing within tolerance only (Conditional Pass\*) will be accepted
  - 7. The contractor shall perform 100% testing of all newly installed backbone cable.
  - 8. Test Results will include:
    - a. Applicable Telecommunications Room number
    - b. Wire Map – will include the following:
      - i) Continuity to the remote end
      - ii) Shorts between any two or more conductors
      - iii) Crossed pairs
      - iv) Reversed pairs
      - v) Split pairs
      - vi) Any other miswiring

### **3.15 OWNER INSTRUCTION AND DEMONSTRATION**

- A. Provide a complete review of the project and systems including, but not limited to, the following:
  - 1. Review each Record Drawing (use of typicals is acceptable).
  - 2. Note equipment layouts, locations and control points.

3. Review each system.
  4. Review system design operation and philosophy.
  5. Review alarms and necessary responses.
  6. Review standard troubleshooting techniques for each system.
  7. Review areas served by equipment.
  8. Identify color codes used.
  9. Review features and special functions.
  10. Review maintenance requirements.
  11. Review operation and maintenance manuals.
  12. Respond to questions (record questions and answers).
- B. Conduct walking tour of Project and briefly describe function, operation, and maintenance of each component after training described above.

### **3.16 DOCUMENTATION**

- A. Provide written certificate(s) and include a copy with the O&M manuals, indicating that the inspections and tests specified herein have been performed, that Owner Training and Demonstration, and that the installation is in accordance with these specifications. Certificate shall be signed and dated by Contractor.
- B. Publish testing results in book format and electronically and include with Operation and Maintenance Manual.

### **3.17 CLEANING**

- A. Provide final cleaning, protection, and maintain conditions in a manner acceptable to manufacture, which ensures system being free from damage and deterioration at time of Substantial Completion.
- B. In all telecom room spaces - a thorough sweeping, vacuuming and wet mopping shall be performed on a weekly basis or more frequently as directed by the owner. Cleaning shall include floors, rafters, floor joists, exposed structural members, exposed mechanical/electrical equipment and ductwork/piping/conduits, walls, ladder trays, tops of cabinets/racks, existing/new passive and active components, or per manufacturer recommendations.
- C. All non-metallic cable managers and snap covers shall be wiped clean, both inside and outside of front, including rear channels. All clear covers and doors shall be cleaned, both front and rear per manufacturer recommendations.
- D. All scraps, boxes, spools, pull-line and trash shall be removed and properly disposed of.
- E. All residual cable lubricant shall be cleaned from floors and walls with an appropriate degreaser.

### **END OF SECTION**



# **SECTION 28 3113 - FIRE ALARM AND DETECTION SYSTEM**

## **PART 1 - GENERAL**

### **1.01 SECTION INCLUDES**

- A. This Section includes fire alarm and detection system, including, but not limited to, the following:
  - 1. Initiating devices.
  - 2. Notification appliances.
  - 3. Control devices.
  - 4. Supervisory devices.
  - 5. Annunciators.
  - 6. Power supplies.
  - 7. Wiring.
  - 8. Testing.

### **1.02 RELATED SECTIONS**

- A. Drawings, addenda and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification Sections, apply to this and all other sections of Division 26, 27, 28.
- B. Division 07 (Section 07 8400) – Firestopping.
- C. Division 08 – Door Hardware.
- D. Division 21 – Sprinkler System
- E. Division 25 – Automatic Temperature Controls.
- F. See Section 26 0500 Common Work Results for Electrical for hangars and supports.
- G. See Section 26 0533 for conduit and raceways.
- H. See Section 26 0553 Identification for Electrical Systems.

### **1.03 REFERENCES**

- A. UL 1424 - Cables for Power-Limited Fire-Alarm Circuits.
- B. UL 2196 - Tests for Fire Resistive Cables.

### **1.04 DEFINITIONS**

- A. Qualified Service Personnel / Representative: Personnel qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall include individuals with the following qualifications:
  - 1. Factory trained and certified.
  - 2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
  - 3. International Municipal Signal Association (IMSA) fire alarm certified.
  - 4. Certified by a state or local authority.
  - 5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
  - 6. Personnel licensed or certified by state or local authority.

## 1.05 SCOPE OF WORK

- A. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of extensions to the existing fire alarm and detection system as indicated on the drawings and specifications. The system extensions shall be complete and the system shall be left fully operational.

## 1.06 DESCRIPTION OF SYSTEM

- A. Manufacturer:
  - 1. Subject to compliance with requirements, alternate products by one of the following shall be acceptable:
    - a. Siemens Fire Safety
    - b. Edwards Systems Technology
    - c. Notifier
  - 2. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.
- B. General: Non-coded, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
- C. Wiring/Signal Transmission:
  - 1. Transmission shall be hard-wired, using separate individual circuits for each zone of alarm operation as required or addressable signal transmission, dedicated to fire alarm service only.
  - 2. System connections for initiating, signaling line circuits and notification appliance circuits shall be Class B.
  - 3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- D. Analog Smoke Sensors:
  - 1. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.
  - 2. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.
- E. Audible Alarm Notification: By horns in areas as indicated on drawings.
- F. Fire Suppression Monitoring:
  - 1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
  - 2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
  - 3. WSO: Water flow switch and sprinkler valve tamper switch shall be connected to dedicated individual addressable monitoring devices. Activation of either device shall distinctly report which device is in alarm on the initiating zone.
- G. Power Requirements
  - 1. Provide additional battery capacity to ensure that the system has sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 10 minutes of alarm operation at the end of this period. The system shall automatically



- transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
2. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

#### **1.07 REGULATORY REQUIREMENTS**

- A. Upon completion the system extensions and all associated operations shall be in accordance with the following Codes:
  1. International Building Code, IBC
  2. International Fire Code, IFC
  3. State of Minnesota Fire Codes and Building Codes.
  4. NFPA 72, National Fire Alarm Code
  5. NFPA 70, National Electrical Code
  6. NFPA 101, Life Safety Code
  7. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
  8. Other applicable NFPA standards
  9. Local Jurisdictional Adopted Codes and Standards
  10. ADA Accessibility Guidelines.

#### **1.08 QUALITY ASSURANCE**

- A. System Integrator: Company specializing in smoke detection, fire, and mass notification alarm systems with five years experience and that have personnel who possess a full knowledge and understanding of systems used for fire alarm and that have factory-trained personnel to perform system design installation, testing, training, and maintenance.
- B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems.
- C. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

#### **1.09 SUBMITTALS FOR REVIEW**

- A. Submit the following per the requirements of Division 01 and Section – Electrical General Requirements.
- B. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
- C. Wiring diagrams from manufacturer.
- D. Shop drawings showing system details including location of FACP, all devices, circuiting, device wiring details, and details of graphic annunciator (if applicable).
- E. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
- F. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, NAC, relay, Sensor, and auxiliary control circuits.

- G. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

#### **1.10 SUBMITTALS FOR INFORMATION**

- A. Submit the following per the requirements of Division 01 and Section – Electrical General Requirements
- B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions if required to make clarifications or revisions to obtain approval.

#### **1.11 SUBMITTALS FOR CLOSEOUT**

- A. Submit the following per the requirements of Division 01 and Section 26 0100.
- B. Operation and Maintenance Manuals:
  - 1. In addition to information required by section "Operation and Maintenance of Electrical Systems", provide a Fire Alarm System Record of Completion in accordance with NFPA 72. Submit on form similar or identical to Figure 4.5.2.1 from NFPA 72.
  - 2. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
  - 3. Operating instructions for FACP.
  - 4. Record of field tests of system.
- C. Project record drawings. Note revisions to approved shop drawings.

### **PART 2 - PRODUCTS**

#### **2.01 REMOTE LCD ANNUNCIATOR**

- A. Provide where required a remote LCD Annunciator with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.
- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.
- C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
  - 1. 40 character custom location label.
  - 2. Type of device (e.g., smoke, pull station, waterflow).
  - 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

## **2.02 EMERGENCY POWER SUPPLY**

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid or nickel cadmium type. Provide additional battery capacity sufficient to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 5 minutes.

## **2.03 ADDRESSABLE DEVICES – GENERAL**

- A. Provide address-setting means.
- B. Detectors shall be ceiling-mounted and shall include separate twist-lock base with tamper-proof feature.
- C. Detectors shall provide test means whereby they will simulate alarm condition and report that condition to control panel. Such test shall be initiated at detector itself by activating magnetic switch or initiated remotely on command from control panel.
- D. Connect to fire alarm control panel's Signaling Line Circuits.
- E. Addressable Thermal and Smoke Detectors: Provide status LEDs. LEDs shall flash under normal conditions, indicating detector is operational and in regular communication with control panel, and LEDs shall be placed into steady illumination by control panel, indicating alarm condition has been detected. If required, flashing mode operation of detector LEDs can be programmed off via fire control panel program.
- F. Fire Alarm Control Panel: Permit detector sensitivity adjustment through field programming of system. Sensitivity can be automatically adjusted by panel on time-of-day basis.
- G. Using software, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. Detectors shall be listed by UL as meeting calibrated sensitivity test requirements of NFPA 72.
- H. Detectors shall provide test means whereby they will simulate alarm condition and report that condition to control panel. Such test shall be initiated at detector itself by activating magnetic switch or initiated remotely on command from control panel.
- I. Detectors shall store internal identifying type code that control panel shall use to identify type of device (ION, PHOTO, THERMAL).

## **2.04 ADDRESSABLE MANUAL PULL STATIONS**

- A. Semi-flush mounted, single action manual station, addressable.
- B. Non-code, non-break glass type, equipped with key lock so they may be tested without operating handle.
- C. Operated Station: Visually apparent, as operated, at a minimum distance of 100 feet (30.5 m) from front or side.
- D. Stations shall be designed so after actual activation, they cannot be restored to normal except by key reset.
- E. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on cover. The word FIRE shall appear on front of stations in raised letters, 1.75 inches (44 mm) or larger.

- F. Addressable manual stations shall, on command from control panel, send data to panel representing state of manual switch and addressable communication module status.
- G. Protective Shield: Where required provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

## 2.05 SMOKE SENSORS

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
  1. Factory Nameplate: Serial number and type identification.
  2. Operating Voltage: 24 VDC, nominal.
  3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
  4. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
  5. Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
  6. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
  7. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
  8. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
  9. Removal of the sensor head for cleaning shall not require the setting of addresses.
- B. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.
- D. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.
  1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
  2. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
  3. Duct Housing shall provide a relay control trouble indicator Yellow LED.
  4. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
  5. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
  6. Duct Housing shall provide a magnetic test area and Red sensor status LED.

7. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
8. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
9. Where indicated provide NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

## **2.06 HEAT SENSORS**

- A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
- C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and] programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
- D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

## **2.07 ADDRESSABLE CIRCUIT INTERFACE MODULES**

- A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.
- B. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.
- C. There shall be the following types of modules:
  1. Type 1: Monitor Circuit Interface Module:
    - a. For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
    - b. For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
  2. Type 2: Line Powered Monitor Circuit Interface Module
    - a. This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.
    - b. This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

3. Type 3: Single Address Multi-Point Interface Modules

- a. This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
- b. This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.
- c. This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

4. Type 4: Line Powered Control Circuit Interface Module

- a. This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

5. Type 5: 4-20 mA Analog Monitor Circuit Interface Module

- a. This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

- D. Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing per the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

## 2.08 STANDARD ALARM NOTIFICATION APPLIANCES

- A. Horn: Piezoelectric type horn shall be listed to UL 464. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
- B. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- C. Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.
- D. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

- E. Alarm lights, horns, speakers shall have red lettered FIRE on white lens.
- F. Accessories: The contractor shall furnish the necessary accessories.

## **2.09 DEVICE GUARDS**

- A. Welded wire mesh, matched to the size and shape of the manual station, detector, indicating device. Painted to match the device.

## **2.10 AUXILIARY DEVICES**

- A. Door Release: Door closer as specified in Division 08.
- B. Magnetic Door Holder: with integral diodes to reduce buzzing, 24 VDC 120 VAC coil voltage.

## **2.11 CONDUIT AND BOXES**

- A. Conduit shall be as specified in Section – Raceways and Boxes for Electrical Systems.
- B. Conduit shall have red pigmentation.
- C. ¾" diameter minimum.

## **2.12 FIRE ALARM WIRE**

- A. Provide wiring as recommended by manufacturer and by system vendor in compliance with local codes.
- B. Conductors shall comply with NFPA 70 Article 760. Conductors shall be stranded copper.
- C. Number and size of conductors will be as specified by the manufacturer (not less than 18 AWG for SLCs and IDCs, and 14 AWG for NACs). All wires shall be color coded as suggested by the Manufacturer.
- D. Power Limited Circuits: 300-volt minimum rated.
- E. Non-Power Limited Circuits: 600-volt minimum rated.
- F. RHW and RHH type cable shall not be acceptable.

# **PART 3 - EXECUTION**

## **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work.
- B. Verify field measurements are as shown on Drawings and instructed by manufacturer.
- C. Verify that required utilities are available, in proper location, and ready for use.

## **3.02 PREPARATION**

- A. Notify the Authority Having Jurisdiction, prior to installation and / or alteration of existing system.
- B. Review manufacturer's approved shop drawings prior to beginning installation.
- C. Coordinate mounting heights with Architect, manufacturer's installation instructions, and applicable code requirements.
- D. Coordinate route of any required surface mounted conduit and / or raceway located at a public or finished space with Architect prior to rough-in.

- E. Coordinate detector locations with luminaires and air supply and return grilles.
- F. Coordinate location of duct mounted detectors with mechanical contractor.

### **3.03 INSTALLATION**

- A. Beginning of installation means installer accepts conditions.
- B. Install system components and all associated devices in accordance with manufacturer's approved shop drawings, applicable Building Codes, Fire Codes, and NFPA Standards. All devices shall be mounted and installed to comply with NFPA 72 and to meet ADA requirements.
- C. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.
- D. Install similar devices at the same height unless noted otherwise.
- E. All wiring under this Section shall be in enclosed raceway.
- F. Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- G. Make conduit and wiring connections to all devices required for complete system operation as noted on drawings and specified herein.
- H. The contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
- I. Smoke and Heat Detector Spacing:
  - 1. Comply with NFPA 72 "Initiating Devices" chapter for spacing of smoke and heat detectors.
  - 2. Locate detectors 3-feet away from air-supply diffusers and return air openings minimum.
  - 3. Locate detectors 1-foot away from light fixtures minimum.
- J. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes to extend the full width of the duct.
- K. Audible Alarm Indicating Devices: Install not less than 6-inches below ceiling.
- L. Visible Alarm Indicating Devices: Install bottom of lens 80-inches above finished floor minimum, and at least 6-inches below ceiling.
- M. Annunciator: Install top of panel not more than 72-inches above finished floor.
- N. Provide individual addressable modules:
  - 1. At each smoke damper.
  - 2. At each smoke evacuation fan controller.
  - 3. For each elevator controller.
  - 4. For each elevator shunt trip enclosed switch or circuit breaker.
  - 5. At each lighting control panel to operate emergency lights upon alarm condition.
  - 6. To provide supervisory connections at valve supervisory switches.
  - 7. To provide supervisory of low air pressure at each dry-pipe sprinkler system.
  - 8. To provide supervisory of elevator shunt trip switch or circuit breaker.
  - 9. To provide supervisory functions at fire pump (supervisory of power failure).
  - 10. At each delayed egress door.



- O. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.
- P. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AH) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).
- Q. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- R. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

### **3.04 FIELD QUALITY CONTROL**

- A. Utilize manufacturer's approved shop drawings during installation.
- B. Manufacturer's Field Services: Provide services of a factory-authorized qualified service representative to supervise the field assembly and connection of components and the pretesting, and final testing.
- C. Performance Verification Testing
  - 1. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications.
    - a. Correct deficiencies observed in pretesting.
    - b. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
  - 2. Test the system according to the procedures outlined in NFPA 72.
  - 3. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies.
  - 4. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- D. Acceptance Testing (By the Authority Having Jurisdiction)
  - 1. Contractor shall schedule test.
  - 2. Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing to be provided by the Authority Having Jurisdiction.
  - 3. Notify Architect of any deficiencies.

### **3.05 DOCUMENTATION**

- A. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.

### **3.06 CLEANING**

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean devices internally using methods and materials recommended by manufacturer.

## **END OF SECTION**



## **SECTION 31 1010 SITE CLEARING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Removing designated paving, curbs, sidewalks, and driveways.
  - 2. Salvaging miscellaneous structures.
  - 3. Topsoil excavation.
- B. Related Sections:
  - 1. Section 31 23 16 – Excavation.
  - 2. Section 31 25 13 – Erosion Controls.

### **PART 2 PRODUCTS**

Not Used.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. Perform Work in accordance with MnDOT Standard Specifications for Construction – 2016 Edition, Section 2101, 2104, and 2105.
- B. The General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code or instruction.

#### **3.2 EXAMINATION**

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify existing plant life designated to remain is tagged or identified
- C. Identify area for placing removed materials.

#### **3.3 PREPARATION**

- A. Notify Utility Companies prior to performing any Work. Call Gopher State One Call: 1-800-252-1166.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
  - 2. Coordinate any required relocation of underground utilities with utility owner.

#### **3.4 PROTECTION**

- A. Locate, identify, and protect utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping as shown in the Plans.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

#### **3.5 MISCELLANEOUS REMOVALS**

- A. Prior to beginning removals, the Engineer or Owner will mark the limits of the features to be removed. The limits shall be reviewed on-site by the Contractor and the Owner's on-site representative.
- B. Remove debris, rock, and extracted plant life from site.
- C. Partially remove paving, curbs, sidewalks, and driveways as indicated on Drawings. Neatly saw cut edges at right angle to surface.
- D. Items indicated to be salvaged shall be done so with minimum damage and stored until reinstallation or moved to a storage location as directed by the Owner.
- E. Any item removed that is not to be salvaged or reused on the project shall be disposed of offsite by the Contractor in accordance with MnDOT Standard Specifications for Construction – 2016 Edition, Section 2104.
- F. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- G. Conduct removal of waste materials as to minimize interference with vehicular and pedestrian traffic.
- H. Do not burn or bury materials on site. Leave site in clean condition.

### **3.6 TOPSOIL EXCAVATION**

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile topsoil to be reused on-site in area determined by the Contractor and approved by the Owner/Engineer.
- D. Protect stockpiled topsoil from erosion in accordance with NPDES permit requirements.
- E. Remove excess topsoil not intended for reuse, from site.

### **3.7 SCHEDULES**

- A. Schedule work under the provision of Section 01 30 00 – Administrative Procedures, and in accordance with the Work restrictions in Section 01 10 00 – Summary of Work.

**END OF SECTION**

## **SECTION 31 2000 EARTHWORK**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. A. Section Includes:
  - 1. 1. Preparing subgrades for slabs, walks, and concrete/ bituminous pavements.
  - 2. 2. Drainage course for slabs and pavements.
  - 3. 3. Fill material as required to construct grades as shown.
  - 4. 4. Topsoil installation.

#### **1.2 DEFINITIONS**

- A. Backfill: Material meeting the requirements of Section 31 23 17.
- B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- C. Topsoil: Sandy loam soil, free of clay lumps, stones, and other objects over 1 inch in diameter, without weeds, roots, sticks and other objectionable material to be used where sod and seed installation is required.
- D. Engineered Fill: Soil materials used to raise existing grades.
- E. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material  $\frac{3}{4}$  cubic yards or more in volume that exceed standard penetration resistance of 100 blows/2 inches when tested by an independent geotechnical testing agency, per ASTM D1586.
- F. Structures: Buildings, footings, foundations, retaining walls, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- G. Subgrade: Surface or elevation remaining after completing excavation, or top surface of fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### **1.3 SUBMITTALS**

- A. Material Test Reports: From qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
  - 1. Classification per ASTM D2487 of each soil material proposed for fill and backfill.
  - 2. Laboratory compaction curve per ASTM D698 for each soil material proposed for fill and backfill.
- B. Pre-excavation Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Must be submitted to Owner/Engineer before earthwork begins. All preconstruction damage should be documented.

#### **1.4 QUALITY ASSURANCE**

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified per ASTM E329 to conduct soil materials and rock-definition testing, as documented per ASTM D3740 and ASTM E548.

## **1.5 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services per requirements indicated.
  - 1. Notify Engineer not less than 2 days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.
  - 3. Contact Gopher State One Call before excavating.
  - 4. Retain the services of a private utility locating company to locate all "private" utilities not addressed by the Gopher State One Call System.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with Owner and utility companies to shut off services if lines are active.
- C. Data from, Soil Investigation Data, included in this project manual was used for basis of design. This information is not intended as representations or warranties of accuracy or continuity between soils information. It is expressly understood that Owner will not be responsible for interpretations drawn there from Contractor. Data are made available for the convenience of Contractor.

## **PART 2 PRODUCTS**

### **2.1 SOIL MATERIALS**

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D2487 Soil Classification Groups GW, GP, SW, and SP, or combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SM, SC, CL, ML, OL, CH, MH, OH, and PT per ASTM D2487, or combination of these groups, unless approved by Geotechnical Consultant.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, stone, and/or sand; ASTM D2940; with at least 90 percent passing 1-1/2 inch sieve and not more than 10 percent (3 percent if fill is within 2 feet of seasonal high ground water elevation) passing No. 200 sieve. Engineered fill shall be free-draining and non-frost susceptible. Engineered fill shall also be approved by Project Geotechnical Engineer.
- E. Topsoil shall be new and imported materials. Topsoil found on the site may be used only if approved in advance by the Owner. The topsoil, whether it is new or salvaged, should be screened and pulverized. The topsoil should be dry and ready to be fine graded.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Prepare subgrade for earthwork operations, including removal of vegetation, topsoil, debris, obstructions, and deleterious materials, from ground surface.
- C. Protect and maintain erosion and sedimentation controls.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

### **3.2 EXCAVATION**

- A. Excavation is Unclassified, and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.
  - 1. Earth Excavation includes excavation of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

### **3.3 STABILITY OF EXCAVATIONS**

- A. General: Comply with local codes, ordinances and requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

### **3.4 DEWATERING**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
  - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
  - 2. Install dewatering system as required to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required. Refer to Project geotechnical report and addenda for information related to ground water elevations.
  - 3. Dewatering systems to include measures to prevent sediment transport in accordance with MPCA regulations.
  - 4. All dewatering costs are considered incidental and are to be included in the earthwork costs for the project.

### **3.5 EXPLOSIVES**

- A. The use of explosives is not permitted.

### **3.6 STORAGE OF EXCAVATED MATERIALS**

- A. Stockpile satisfactory excavated materials until required for backfill or fill. Place, grade and shape stockpiles for proper drainage. Provide erosion and sediment control measures in accordance with MPCA guidelines.
- B. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
- C. Dispose of excess soil material and waste materials as herein specified.

### **3.7 EXCAVATION OF PAVEMENTS**

- A. Cut surface under pavements to comply with cross-sections, elevations and grades as shown.

### **3.8 COLD WEATHER PROTECTION**

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

### **3.9 BACKFILL AND FILL**

- A. General: Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in Part 2 of this Section.
  - 1. Under grassed areas, use satisfactory excavated or borrow material.
  - 2. Under walks and pavements, use engineered fill, satisfactory excavated or borrow material, or combination. Material to be placed to the bottom of the aggregate base.
  - 3. Under steps, use engineered fill.
  - 4. Under piping and conduit, use engineered fill for bedding and for correction of unauthorized excavation. Shape excavation bottom to fit bottom 90 degrees of cylinder.
  - 5. Backfill trenches with the materials required above, depending on the location of the utilities.
    - a. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Owner's Geotechnical Consultant. Use care in backfilling to avoid damage or displacement of pipe systems.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:
  - 1. Acceptance of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.
  - 2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
  - 3. Removal of concrete formwork.
  - 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
  - 5. Removal of trash and debris from excavation.
  - 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

### **3.10 PLACEMENT AND COMPACTION**

- A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills.
- B. Inspection: Prior to placement of fill, excavations shall be inspected by the Testing Agency to verify that all unsuitable materials have been properly removed. Where granular soils are present at the bottom of the excavation, the native soils within 18 inches of the exposed



grade shall be compacted with a large vibratory roller to not less than 98% standard proctor density (ASTM D698).

1. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.
- C. Place backfill and fill materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- E. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.
- F. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Testing Agency if soil density tests indicate inadequate compaction.
- G. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D698:
  1. Under structures, slabs, steps, and pavements, compact top 12 inches of subgrade and each layer of backfill or fill material at 98 percent maximum density.
  2. Under lawn or unpaved areas, compact top 6 inches of subgrade and each layer of backfill or fill material at 95 percent maximum density.
  3. Under sidewalks, compact top 6 inches of subgrade and each layer of backfill or fill material at 98 percent maximum density.
- H. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. (This material is not acceptable for building fill).
  1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
  2. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by disking, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

### **3.11 ROUGH GRADING**

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.

1. Where new sod, seed, planting beds, or other vegetative matter are shown within construction limits defined on drawings, remove existing fill soil material to depth required for topsoil and replace with new import topsoil material. See Section 325800 Landscaping for additional requirements for topsoil.
- B. Do not remove topsoil when wet.
- C. Make soil corrections defined in the Geotechnical Report; follow procedures and use materials defined in the Report. Generally:
1. For slabs that occur in areas of existing exterior pavement, assume that existing fill material is adequately compacted for new slabs. Strip existing pavement and underlying soil material to a depth required for new slab on grade and base aggregate; obtain approval of on-site Geotechnical consultant before proceeding with surface compaction of resultant surface.
  2. For slabs that occur in existing non-pavement areas, remove existing unsuitable fill soils and prepare similar to specified above.
  3. For non-pervious pavement surfaces, subcut the existing soil to allow the new pavement and base aggregate. Obtain approval of on-site Geotechnical consultant before proceeding with surface compaction of the exposed, existing soil surface.
  4. For infiltration basin, subcut the existing soil to allow for the new drainage aggregates.
- D. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- E. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- F. When excavations extend below footing, pavement and slab bearing elevations, oversize the excavation horizontally 1 foot for every foot of excavation depth below the indicated bearing elevation.
- G. When excavating through roots, perform work by hand and cut roots with sharp axe.
- H. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- I. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

### **3.12 TOLERANCES**

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
- B. Grading: Grade areas as indicated in the plans to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:
1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10-foot above or below required subgrade elevations.
  2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10-foot above or below required subgrade elevation.

- 3. Pavements: Shape surface or areas under pavement to line, grade, and cross-section, with finish surface not more than 0.5-inch above or below required subgrade elevation. Subgrade shall be graded to drain to drain tile locations.
- C. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

**3.13 TRENCHING**

- A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove excavated material that is unsuitable for re-use from site.
- H. Remove excess excavated material from site.
- I. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- J. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- K. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

**3.14 FIELD QUALITY CONTROL**

- A. Quality assurance testing is the responsibility of the Contractor. The Contractor shall employ the services of an independent materials testing firm to provide the final test information. The Contractor may use their own personnel to provide tests of the materials during the placement and compaction operations; however, an independent testing firm must take the final tests. The testing firm shall test the materials as construction work is performed.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed Work comply with requirements.
- C. Testing agency will test compaction of soils in place per ASTM D1556, ASTM D2167, ASTM D2922, and ASTM D2937, as applicable. Perform tests at the following locations and frequencies:

<u>Description</u>	<u>Minimum % Standard Proctor</u>	<u>Minimum Tests/ Unit Area/Lift</u>
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Natural sub-grade	95%	1/1000 sq. yds
Fill under paved and concrete areas	100% (top 3') 95% (below 3')	1/500 sq. yds
Class 5 material under slabs/pavement	100%	1/500 sq. yds.
Landscape fill areas	90%	1/1000 sq. yds.

- D. Field Density Test Report shall clearly identify the following information for each test:
1. Horizontal and vertical location of test.
  2. Material type being tested.
  3. Proctor test method.
  4. Maximum proctor density.
  5. Specified density.
  6. Optimum moisture density.
  7. Field test method.
  8. Actual moisture content.
  9. Actual dry density.
  10. Pass/fail indication.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained. Consult Project Geotechnical Engineer for additional or supplemental recommendations.

### **3.15 PROTECTION**

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and re-compact.
- C. Where settling occurs after hard surface installation is completed, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent Work, and eliminate evidence of restoration to greatest extent possible.

### **3.16 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

**END OF SECTION**

## **SECTION 31 2316 EXCAVATION**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Subgrade excavation.
  - 2. Subgrade fill and preparation.
  - 3. Excavation for paving, roads, and parking areas.
  - 4. Geotextile fabric.
- B. Related Sections:
  - 1. Section 31 23 17 – Trenching.
  - 2. Section 32 11 23 – Aggregate Base Course.
  - 3. Section 32 12 16 – Asphalt Paving.
  - 4. Section 32 13 13 – Concrete Paving.

#### **1.2 REFERENCES**

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
  - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>

#### **1.3 SUBMITTALS**

- A. Materials Source: Submit name of imported fill materials suppliers.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### **1.4 FIELD MEASUREMENTS**

- A. Verify field measurements prior to fabrication.

### **PART 2 PRODUCTS**

#### **2.1 FILL MATERIALS**

- A. Sub-grade material shall be granular borrow material as specified in MnDOT Standard Specification for Construction – 2016 Edition, Section 3149.2B1.

- B. Topsoil material shall be topsoil borrow material according to MnDOT Standard Specification for Construction – 2016 Edition, Section 3877.2A for general use as a turf growing medium.

## **2.2 GEOTEXTILE FABRIC**

- A. Geotextile fabric, Type V (non-woven) in accordance with MnDOT Standard Specification for Construction – 2016 Edition, Section 3733.

## **2.3 SUBSURFACE DRAINS**

- A. Subsurface drains shall be in accordance with MnDOT Standard Specification for Construction – 2016 Edition, Section 3278.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Perform work in accordance with MnDOT Standard Specifications for Construction – 2016 Edition, Section 2105 and Section 2112 except as modified herein.
- B. The EJCDC General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code or instruction.

### **3.2 EXAMINATION**

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

### **3.3 PREPARATION**

- A. Notify Utility Companies prior to performing any work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum.
- C. Notify utility companies of any utilities that need to be relocated, removed or worked around.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### **3.4 SUBGRADE EXCAVATION**

- A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.
- B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.
- C. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- D. Remove excess subsoil not intended for reuse, from site.
- E. Excess materials or materials not to be reused on-site shall be disposed of in accordance with MnDOT 2104.3C.
- F. Stockpile excavated material to be reused on site in area agreed upon by the Owner/Engineer.

- G. Replace damaged or displaced subsoil as specified for fill.

### **3.5 SUBGRADE FILL AND PREPARATION**

- A. Fill areas to contours and elevations with unfrozen materials.
- B. Roads, ditches and green spaces shall be reconstructed to the same grade, shape and condition as prior to the project, unless otherwise stated on the plans or in the specifications.
- C. When the soils are so varied that selection and placement of uniform soils is not practical, the Contractor shall use disks, plows, graders or other equipment to blend and mix suitable soils to produce a uniform soil texture, moisture content and density; except that, all soils that contain 20 percent or more particles passing the #200 sieve shall be blended, mixed and dried with a disk, within the entire upper 6 feet of embankment. The disk shall meet the requirements of 2123 N, Disk Harrow. A disk is also to be used below the upper 6 feet of the embankment fill area, if in the opinion of the Engineer, the Contractor is not producing a uniform soil texture.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Compaction of all fill construction shall be obtained by the "Specified Density" method as described in MnDOT 2105.3F1.
- F. The Contractor shall coordinate sub-grade construction with the Engineer for the scheduling of testing for compaction.
- G. Make grade changes gradual. Blend slope into level areas.
- H. Repair or replace items indicated to remain damaged by excavation or filling.
- I. The replacement of aggregate surfacing, bituminous pavement and concrete pavement shall be as shown on the Plans.
- J. The Contractor shall maintain all surfaced areas until completion of the project.

### **3.6 SUBSURFACE DRAINS**

- A. Drain tiles and other subsurface drains shall be constructed in accordance with MnDOT Standard Specifications for Construction – 2016 Edition, Section 2502.

### **3.7 TOLERANCES**

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

### **3.8 FIELD QUALITY CONTROL**

- A. Borrow Material
  - 1. A sieve analysis of the borrow material to be used shall be supplied by the Contractor prior to use for each borrow source.
  - 2. Three samples shall be taken for sieve analysis on the first day of production.
    - a. One sample shall be tested and if passing, no other testing is necessary.
    - b. If the first sample fails, the other two samples shall be tested to determine acceptance and payment reductions.
    - c. If samples continue to fail, the Engineer reserves the right to stop work until suitable material and passing tests are obtained.

### **3.9 PROTECTION**

- A. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operation.

**END OF SECTION**



## **SECTION 31 2317 TRENCHING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Excavating trenches for utilities.
  - 2. Compacted fill from top of utility bedding to subgrade elevations.
  - 3. Backfilling and compaction.
- B. Related Sections:
  - 1. Section 33 40 00 – Storm Drainage Utilities.
  - 2. Section 33 30 00 – Sanitary Sewerage Utilities
  - 3. Section 33 11 16 – Water Utility Distribution Piping

#### **1.2 REFERENCES**

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
  - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - 2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - 3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
  - 5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

#### **1.3 DEFINITIONS**

- A. Utility: Any buried pipe, duct, conduit, or cable.
- B. Structure: Any hydrant, curb stop, gate valve, manhole, cleanout or catch basin.

#### **1.4 SUBMITTALS**

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- C. Product Data: Submit data for geotextile fabric indicating fabric and construction.
- D. Product Data: Submit a sieve analysis of borrow material; granular, crushed rock or any imported materials, to be used on the project prior to use of the material on the project.

- E. Materials Source: Submit name of imported fill materials suppliers.
- F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

### **1.5 QUALIFICATIONS**

- A. Prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Minnesota.

### **1.6 FIELD MEASUREMENTS**

- A. Verify field measurements prior to fabrication.

### **1.7 COORDINATION**

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

## **PART 2 PRODUCTS**

### **2.1 GRANULAR BORROW**

- A. Granular borrow for use as bedding or fill material shall be Class II materials as identified by ASTM D2321 and show in the table below.

### **2.2 CRUSHED ROCK**

- A. Crushed rock for use as bedding or fill material shall be Class IA or Class IB materials as identified by ASTM D2321 and shown in the table below.

ASTM D2321 <sup>(1)</sup> Class Description		Notation	ASTM D2487 Description	AASHTO M43 Notation	Min. Compaction Required (Std. Proctor Density %) <sup>(2)</sup>	ASTM D2321 <sup>(1)</sup>						
						Percentage Passing Sieve Sizes			Atterberg Limits		Coefficients	
						1 ½ in. (40mm)	No. 4 (4.75mm)	No. 200 (0.075mm)	LL	PI	Uniformity Cu	Curvature Cc
IA <sup>(4)</sup>	Open-graded, clean manufactured aggregates	N/A	Angular crushed stone or rock, crushed gravel, crushed slag; large voids with little or no fines	5 56	Dumped to Slight	100%	□ 10%	<5%	Non Plastic		N/A	
IB	Dense- graded, clean manufactured, processed aggregates	N/A	Angular crushed stone or other Class IA material and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; little or no fines			100%	□ 50%	<5%	Non Plastic			
II	Clean, coarse- grained soils	GW	Well-graded gravel, gravel-sand mixtures; little or no fines	57 6 67	Moderate (85%)	100%	<50% of "Coarse Fraction"	<5%	Non Plastic	>4	1 to 3	
		GP	Poorly-graded gravels, gravel-sand mixtures; little or no fines							<4	<1 or >3	
		SW	Well-graded sands, gravelly sands; little or no fines							>6	1 to 3	
		SP	Poorly-graded sands, gravelly sands; little or no fines							<6	<1 or >3	
	Coarse- Grained Soils, borderline clean to w/fines	GW-GC, SP-SM	Sands and gravels which are borderline between clean and with fines	N/A	100%	Varies	5% to 12%	Non Plastic	Same as for GW, GP, SW and SP			
III	Coarse- grained soils with fines	GM	Silty gravels, gravel-sand- silt mixtures	Gravel & sand with <10% fines	Moderate to High (90%)	100%	<50% of "Coarse Fraction"	12% to 50%	N/A	<4 or <"A" Line	N/A	
		GC	Clayey gravels, gravel- sand-clay mixtures							>7 & >"A" Line		
		SM	Silty sands, sand-silt mixtures							>4 or <"A" Line		
		SC	Clayey sands, sand-clay mixtures							>7 & >"A" Line		
IVA <sup>(2)</sup>	Inorganic fine- grained soils	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, silts with slight plasticity	N/A	N/R	100%	100%	>50%	<50	<4 or <"A" Line	N/A	
		CL	Inorganic clays of low to medium plasticity; gravelly, sandy, or silty clays; lean clays	N/A						>7 & >"A" Line		
IVB	Inorganic fine- grained soils	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic sils	N/A	N/R	100%	100%	>50%	>50	<"A" Line	N/A	
		CH	Inorganic clays of high plasticity, fat clays	N/A						>"A" Line		
V	Organic soils or Highly organic soils	OL	Organic silts and organic silty clays of low plasticity	N/A	N/R	100%	100%	>50%	<50	<4 or <"A" Line	N/A	
		OH	Organic clays of medium to high plasticity, organic sils	N/A						<"A" Line		
		PT	Peat and other high organic soils	N/A						>50		

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Execution shall be in accordance with ASTM D2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications", AWWA C600, "AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances", AWWA Standard 605, "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water" and as shown in the plans except as modified herein.
- B. The EJCDC General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code or instruction.

### 3.2 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
  - 1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

### 3.3 PREPARATION

- A. Notify Utility Companies prior to performing any work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.
- G. Excavations in excess of 20 feet shall be designed by a licensed Engineer and a copy of this design shall be forwarded to the Engineer for their records.

### 3.4 TRENCHING

- A. All excavations and trenches must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, "Excavations and Trenches".
- B. Remove lumped subsoil, boulders, and rock up of **1/6 cubic yard** measured by volume.
- C. Do not advance open trench more than **200 feet** ahead of installed pipe.
- D. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
- E. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.
- F. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered and fill with granular or crushed rock material.
- G. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.
- H. Excavated non-organic materials shall be salvaged and stockpiled for use as subgrade materials and for the replacement of any unsuitable materials encountered during utility installation.
- I. Excess non-organic materials not used for subgrade materials or for the replacement of unsuitable materials shall be removed from site.

### **3.5 SHEETING AND SHORING**

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than **5 feet** deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

### **3.6 BACKFILLING**

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. No stones exceeding 6 inches in greatest dimension will be permitted in the upper 3 feet of the roadbed embankment.
- C. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- D. Place fill material in continuous layers and compact in accordance with ASTM D2321 Specifications.
- E. Compaction of all trench backfill shall be obtained by the "Specified Density Compaction" method described in MnDOT 2105.3F1.
- F. The Contractor shall coordinate backfilling operations with the Engineer for the scheduling of testing for compaction.
- G. Maintain optimum moisture content of fill materials to attain required compaction density.
- H. The Contractor shall scarify, dry the backfill material, or apply water as may be necessary to obtain the required density and stability.
- I. In order to prevent future settlement of roads, lawns, driveways, and utilities, the Contractor shall compact uniformly and entirely, careful not to omit any areas.
- J. Do not leave trench open at end of working day.
- K. Protect open trench to prevent danger to the public.

### **3.7 TOLERANCES**

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Top Surface of Backfilling under paved areas: Plus or minus 1/4 inch from required elevations.
- C. Top Surface of General Backfilling: Plus or minus 1inch from required elevations.

### **3.8 FIELD QUALITY CONTROL**

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Borrow Material

1. A sieve analysis of the borrow material to be used shall be supplied by the Contractor prior to use for each borrow source.
2. Three samples shall be taken for sieve analysis on the first day of production.
  - a. One sample shall be tested and if passing, no other testing is necessary.
  - b. If the first sample fails, the other two samples shall be tested to determine acceptance and payment reductions.
  - c. If samples continue to fail, the Engineer reserves the right to stop work until suitable material and passing tests are obtained.

### **3.9 PROTECTION OF FINISHED WORK**

- A. Section 01 7000 - Execution and Closeout Requirements: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction

**END OF SECTION**

## **SECTION 31 2323 - FILL**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Filling, backfilling, and compacting for building volume below grade.
- B. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.

#### **1.03 REFERENCE STANDARDS**

- A. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2012.
- B. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2015.
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2012.
- D. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.
- E. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- F. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2015.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.
- C. Compaction Density Test Reports.

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

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.

## **PART 2 PRODUCTS**

### **2.01 FILL MATERIALS**

- A. Provide soil materials for fill and backfill in gradations and compactions as indicated in the geotechnical report.
- B. Sand - Fill Type Clean Granular Fill: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter.
  - 1. At the final 6" fill below concrete floor slabs and as noted otherwise on the Drawings.
  - 2. Grade in accordance with ASTM D2487 Group Symbol SP, unless noted otherwise in geotechnical report.

### **2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the Work are as indicated.
- B. Identify required lines, levels, contours, and datum locations.
- C. See Section 31 2200 for additional requirements.
- D. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- E. Verify structural ability of unsupported walls to support imposed loads by the fill.

### **3.02 PREPARATION**

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

### **3.03 FILLING**

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.



- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches (200 mm) compacted depth.
- G. Slope grade away from building minimum 2 inches in 10 feet (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. Correct areas that are over-excavated in accordance with geotechnical report.
- I. Reshape and re-compact fills subjected to vehicular traffic.

#### **3.04 TOLERANCES**

- A. Top Surface of General Filling: Plus or minus 1 inch (25 mm) from required elevations.

#### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556/D1556M, ASTM D2167, or ASTM D6938.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor") or ASTM D 1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

#### **3.06 CLEANING**

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

### **END OF SECTION**



## **SECTION 31 2513 EROSION CONTROLS**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Erosion Control.
  - 2. Sediment Control.
  - 3. Maintenance during Construction.
  - 4. Air, Land and Water Pollution.
  - 5. NPDES Permits.
- B. Related Sections:
  - 1. Section 01 50 00 – Temporary Facilities and Controls.
  - 2. Section 31 10 00 – Site Clearing.
  - 3. Section 31 23 16 – Excavation.
  - 4. Section 32 58 00 – Landscaping.

#### **1.2 SUBMITTALS**

- A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

### **PART 2 PRODUCTS**

#### **2.1 GENERAL**

- A. Materials shall be as specified in MnDOT Standard Specifications for Construction – 2016 Edition, Section 2573 and 2575.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. Execution shall be as specified in MnDOT Standard Specifications for Construction – 2016 Edition, Section 2573 and 2575, MnDOT Special Provisions and as shown on the Drawings except as modified herein.
- B. The General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code or instruction.

#### **3.2 MAINTENANCE DURING CONSTRUCTION**

- A. Execution shall be as specified in MnDOT Standard Specifications for Construction – 2016 Edition, Section 1514 except as modified herein.
- B. In addition to the Contractor's requirements for sweeping as required under MnDOT 2051 (Maintenance and Restoration of Haul Roads), the Engineer may require additional sweeping of roads adjacent to the construction site to provide safe conditions for the traveling public, for environmental reasons, to meet local regulatory requirements or as otherwise directed by the Engineer.

#### **3.3 AIR, LAND, AND WATER POLLUTION**

- A. Execution shall be as specified in MnDOT Standard Specifications for Construction – 2016 Edition, Section 1717 and as shown on the Drawings except as modified herein.
- B. If during the course of the Project, the Contractor unexpectedly encounters any of the following conditions indicating the possible presence of contaminated soil, contaminated water, or regulated waste, the Contractor shall immediately stop work in the vicinity, notify the Engineer, and request suspension of work in the vicinity of the discovery area, in accordance with MnDOT 1803.4.
- C. A documented inspection and evaluation will be conducted prior to the resumption of work. The Contractor shall not resume work in the suspected area without authorization by the Engineer.
  - 1. Indicators of contaminated soil, ground water or surface water include, but are not limited to the following:
    - a. Odor including gasoline, diesel, creosote (odor of railroad ties), mothballs, or other chemical odor.
    - b. Soil stained green or black (but not because of organic content), or with a dark, oily appearance, or any unusual soil color or texture.
    - c. A rainbow color (sheen) on surface water or soil.
  - 2. Indicators of regulated wastes include, but are not limited to the following:
    - a. Cans, bottles, glass, scrap metal, wood (indicators of solid waste and a possible dump)
    - b. Concrete and asphalt rubble (indicators of demolition waste).
    - c. Roofing materials, shingles, siding, vermiculite, floor tiles, transite or any fibrous material (indicators of demolition waste that could contain asbestos, lead or other chemicals).
    - d. Culverts or other pipes with tar-like coating, insulation or transite (indicators of asbestos).
    - e. Ash (ash from burning of regulated materials may contain lead, asbestos or other chemicals).
    - f. Sandblast residue (could contain lead).
    - g. Treated wood including, but not limited to products referred to as green treat, brown treat and creosote (treated wood disposal is regulated).
    - h. Chemical containers such as storage tanks, drums, filters and other containers (possible sources of chemical contaminants).
    - i. Old basements with intact floor tiles or insulation (could contain asbestos), sumps (could contain chemical waste), waste traps (could contain oily wastes) and cesspools (could contain chemical or oily wastes).

### **3.4 NPDES PERMITS**

- A. Execution shall be in accordance with the rules, regulations, and standards adopted and established by the Minnesota Pollution Control Agency (M.P.C.A.), and as specified in MnDOT Standard Specifications for Construction – 2016 Edition, Section 1717 except as modified herein.
- B. By signing the Proposal and completing the NPDES permit application, the Contractor is a co-permittee with the Owner to ensure compliance with the terms and conditions of the General Storm Water Permit (MN R100001) and is responsible for those portions of the permit where the operator is referenced. This Permit establishes conditions for discharging storm water to waters of the State from construction activities that disturb 0.4 hectares [**1 acre**] or more of total land area. A copy of the "General Permit Authorization to Discharge

Storm Water Associated with a Construction Activity Under the National Pollutant Discharge Elimination System (NPDES)/State Disposal System Permit Program" is available at <http://www.pca.state.mn.us/water/stormwater/stormwater-c.html> or by calling 651-296-3890.

- C. The project is **anticipated** to disturb **1 acre** or more of total land area, therefore an NPDES Permit is required.

### **3.5 TURF ESTABLISHMENT**

- A. See Section 32 58 00 – Landscaping.

**END OF SECTION**



## **SECTION 32 1123 AGGREGATE BASE COURSE**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Aggregate base course.
- B. Related Sections:
  - 1. Section 31 23 16 – Excavation.
  - 2. Section 32 12 16 – Asphalt Paving.
  - 3. Section 32 13 13 – Concrete Paving.

#### **1.2 REFERENCES**

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
  - 1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3  - 2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
  - 3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3  - 4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
  - 5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).</sup></sup>

#### **1.3 SUBMITTALS**

- A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported fill materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### **1.4 QUALITY ASSURANCE**

- A. Furnish each aggregate material from single source throughout the Work.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. The class of aggregate to be used on the project shall be in accordance with MnDOT Standard Specification for Construction – 2016 Edition, Section 3138 except as modified herein.
- B. Replace Table 3138-2 with the following:

<b>Table 3138-2 Quality Requirements for Recycled Materials</b>	
<b>Requirement</b>	<b>Classes 1, 3, 4, 5, 5Q and 6</b>
Maximum Bitumen Content of Composite	3.5%
Maximum Masonry block %	10%
Maximum percentage of glass *	10%
Maximum size of glass *	$\frac{3}{4}$ in [19 mm]
Crushing (Class 5, 5Q and 6)	10% for Class 5 †, 60% for Class 5Q † and 15% for Class 6 †
Maximum amount of Brick	1.0% #
Maximum amount of other objectionable materials including but not limited to: wood, plant matter, plastic, plaster and fabric	0.3% #
* Glass must meet certification requirements on the Grading and Base website. Combine glass with other aggregates during the crushing operation. † If material $\geq$ 20% RAP and/or Concrete, Class 5 crushing requirements is met. † If material $\geq$ 60% RAP and/or Concrete, Class 5Q crushing requirement is met. † If material $\geq$ 30% RAP and/or Concrete, Class 6 crushing requirement is met.    Material crushed from quarries is considered crushed material. # The Contractor/Supplier may not knowingly allow brick and other objectionable material and must employ a QC process to screen it out, before it becomes incorporated into the final product.	

C. Replace MnDOT 3138.2.D(1) with the following.

1. 100% of the material passes the  $\frac{3}{4}$ " [19.0 mm] sieve, regardless of the class specified; this modifies the requirements of Tables 3138-3, 3138-4 and 3138-5 for surfacing aggregates.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. Perform work in accordance with MnDOT Standard Specifications for Construction – 2016 Edition, Section 2211.
- B. The General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code or instruction.

#### **3.2 EXAMINATION**

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify substrate has been inspected, gradients and elevations are correct, and are dry.

#### **3.3 PREPARATION**

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting as needed (also refer to Section 31 23 16 – Excavation).
- B. Do not place fill on soft, muddy, or frozen surfaces.

#### **3.4 AGGREGATE PLACEMENT**



- A. Level and contour surfaces to elevations and gradients indicated.
- B. Maintain optimum moisture content of fill materials to attain required compaction density.
- C. Compaction shall be achieved by the "Specified Density Method" as described in Mn/DOT 2211.3D2a.
  - 1. The full thickness of each layer shall be compacted to not less than 100 percent of maximum density. At the time of compaction, the moisture content of the base material shall be not less than 65 percent of optimum moisture.

### **3.5 TOLERANCES**

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Maximum Variation From Flat Surface: **1/8 inch** measured with **10 foot** straight edge.
- C. Maximum Variation From Thickness: **1/8 inch**.
- D. Maximum Variation From Elevation: **1/8 inch**.

### **3.6 FIELD QUALITY CONTROL**

- A. Section 01 40 00 – Quality Requirements: Field inspecting and testing.
- B. Borrow Material
  - 1. A sieve analysis of the borrow material to be used shall be supplied by the Contractor prior to use for each borrow source.
  - 2. Three samples shall be taken for sieve analysis on the first day of production.
    - a. One sample shall be tested and if passing, no other testing is necessary.
    - b. If the first sample fails, the other two samples shall be tested to determine acceptance and payment reductions.
    - c. If samples continue to fail, the Engineer reserves the right to stop work until suitable material and passing tests are obtained.
- C. The Owner or the Engineer will at random intervals check the depth of aggregate base to ensure conformance with the Contract documents. The Contractor shall be available to verify the Owner/Engineer's measurements and determine any necessary corrective action.

**END OF SECTION**



## **SECTION 32 1216 ASPHALT PAVING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Bituminous paving.
  - 2. Bituminous non-wearing and wearing course.
  - 3. Bituminous tack coat.
  - 4. Pavement markings.
- B. Related Sections:
  - 1. Section 31 23 16 – Excavation.
  - 2. Section 32 11 23 – Aggregate Base Course.

#### **1.2 SUBMITTALS**

- A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit product information and mix design.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### **1.3 QUALITY ASSURANCE**

- A. Obtain materials from same source throughout.

#### **1.4 ENVIRONMENTAL REQUIREMENTS**

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Non-wearing Course: SPNWB340B
  - 1. RAP will be allowed in the bituminous non-wearing course.
- B. Light Duty Wearing Course: SPWEA340B
  - 1. No RAP will be allowed in the bituminous wearing course.
- C. Heavy Duty Wearing Course: SPWEB340B
  - 1. No RAP will be allowed in the bituminous wearing course.
- D. Bituminous Tack Coat:
  - 1. The bituminous material for tack coat will be limited to one of the following kinds of emulsified asphalt. However, the Engineer may authorize the use of medium cure cutback asphalt (MC-250) during the early and late construction season when it is anticipated the air temperature may drop below 32 degrees Fahrenheit.
    - a. Allowable grades are as follows:
      - 1) Emulsified Asphalt
        - a) Anionic: SS-1, SS-1h
        - b) Cationic: CSS-1, CSS-1h
      - 2) Cutback Asphalt
        - a) Medium Cure Liquid Asphalt: MC-250

- b. Only Certified Sources are allowed for use. Mn/DOT's Certified Source List is located at the following link: <http://www.dot.state.mn.us/products/index.html>.

## **2.2 SOURCE QUALITY CONTROL AND TESTS**

- A. Section 01 40 00 – Quality Requirements: Testing and inspection requirements.
- B. Submit proposed mix design of each class of mix for review prior to beginning of Work.
- C. Test samples in accordance with MnDOT Specifications.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Perform Work in accordance with MnDOT Standard Specifications for Construction – 2016 Edition and MnDOT's Plant Mixed Asphalt Pavement (2360).
- B. The General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code or instruction.

### **3.2 EXAMINATION**

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting Work.
- B. Verify compacted aggregate base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Verify catch basin grates and frames and manhole castings are installed in correct position and elevation.

### **3.3 AGGREGATE BASE**

- A. Aggregate base: Install in accordance with Section 32 1123 – Aggregate Base Course.

### **3.4 PREPARATION - TACK COAT**

- A. Apply tack coat in accordance with MnDOT Standard Specifications for Construction – 2016 Edition, Section 2357 except as modified herein.
- B. Tack coat operations shall be conducted in a manner that offers the least inconvenience to traffic, with movement in at least one direction permitted at all times without pickup or tracking of the bituminous material.
- C. The tack coat shall not be applied when the road surface or weather conditions are unsuitable as determined by the Engineer. The daily application of tack coat shall be limited to approximately the area on which construction of the subsequent bituminous course can reasonably be expected to be completed that day.
- D. At the time of applying bituminous tack coat material, the surface shall be dry and clean and all necessary repairs or reconditioning work shall have been completed as provided for in the Contract and approved by the Engineer.
- E. All objectionable foreign matter on the surface shall be removed and disposed of by the Contractor as the Engineer approves.

- F. Preparatory to placing an abutting bituminous course, the contact surfaces of all fixed structures and the edge of the in-place mixture in all courses at transverse joints and in the wearing course at longitudinal joints shall be given a uniform coating of liquid asphalt or emulsified asphalt, applied by methods that will ensure uniform coating.
- G. Unless otherwise indicated in the plans or provisions, the bituminous tack coat material shall be applied within the application rates shown below in Table 2357.2 as based on pavement type or condition and type of bituminous material. The Engineer shall approve the time and rate of application.

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

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

### **3.6 ASPHALT REQUIREMENTS AND PAYMENTS**

- A. The sentence "In addition to the list the above the pavement surface must meet requirements of 2399 (Pavement Surface Smoothness) requirements." is deleted from MnDOT 2360.3.E Surface Requirements. The requirements of MnDOT 2360.3.E Surface Requirements **will** apply.
- B. **The first paragraph of MnDOT 2360.3.D.1** is hereby deleted and replaced with the following:
  - D.1 Maximum Density**  
Compact the pavement to at least the minimum required maximum density values in accordance with Table 2360-19, "Required Minimum Lot Density (Mat)".
- C. MnDOT Table 2360-20 Longitudinal Joint Density Requirement is hereby deleted.
- D. MnDOT 2360.3.D.1.n Longitudinal Joint Density is hereby deleted.
- E. MnDOT 2360.3.D.1.p Shoulders is hereby deleted.
- F. MnDOT Table 2360-24 Payment Schedule for Longitudinal Joint Density (SP Non-Wear and SP Shoulders, 4% Void) is hereby deleted.
- G. MnDOT Table 2360-25 Payment Schedule for Longitudinal Joint Density (SP Non-wear and SP Shoulders, 3% Void) is hereby deleted.
- H. MnDOT 2360.3.D.1.r Pay Factor Determination is hereby deleted.

### **3.7 TOLERANCES**

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Flatness: Maximum variation of 1/8 inch measured with 10 foot straight edge.

- C. Scheduled Compacted Thickness: Within 1/8 inch.
- D. Variation from Indicated Elevation: Within 1/8 inch.

### **3.8 FIELD QUALITY CONTROL**

- A. Section 01 40 00 – Quality Requirements: Field inspection and testing.
- B. On the first day of paving the non-wear and wear courses of bituminous, the Contractor shall establish a roll pattern for the project to obtain the required densities.
- C. The Contractor shall have a Nuclear Test Gauge on-site to assist in establishing the roll pattern and to monitor that the required densities are being obtained for the duration of the paving operation.
- D. Upon completion of each course, the Contractor shall submit a log of the Nuclear Densities taken during the bituminous construction to the Engineer for review.

### **3.9 PROTECTION OF FINISHED WORK**

- A. Immediately after placement, protect pavement from mechanical injury.

**END OF SECTION**

## **SECTION 32 1313 CONCRETE PAVING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete pavements.
  - 2. Concrete sidewalks.
  - 3. Concrete curbs and gutters
- B. Related Sections:
  - 1. Section 31 23 16 – Excavation.
  - 2. Section 32 11 23 – Aggregate Base Course.
  - 3. Section 32 12 16 – Asphalt Paving.

#### **1.2 SUBMITTALS**

- A. Product Data: Submit data on curing compounds.
- B. Submit proposed mix design of each class of concrete to Engineer for review prior to commencement of Work.

#### **1.3 QUALITY ASSURANCE**

- A. Obtain cementitious materials from same source throughout the project.
- B. Obtain aggregate materials from same source throughout the project.

#### **1.4 ENVIRONMENTAL REQUIREMENTS**

- A. Do not place concrete when base surface temperature is less than 40 degrees F or surface is wet or frozen.

### **PART 2 PRODUCTS**

#### **2.1 REINFORCEMENT**

- A. Reinforcing Steel shall be epoxy coated as specified in MnDOT Standard Specification for Construction – 2016 Edition, Section 3301.
- B. Dowel Bar shall be as specified in MnDOT Standard Specification for Construction – 2016 Edition, Section 3302.
- C. Reinforcing Steel Fabric shall be as specified in MnDOT Standard Specification for Construction – 2016 Edition, Section 3303.

#### **2.2 CONCRETE MATERIALS**

- A. Concrete Materials shall be as specified in MnDOT Standard Specification for Construction – 2016 Edition, Section 2461 and MnDOT Special Provisions.

#### **2.3 SOURCE QUALITY CONTROL AND TESTS**

- A. Section 01 40 00 - Quality Requirements: Testing and Inspection Services: Provide mix designs for concrete pavement, concrete curbs and gutters, and concrete sidewalks.
- B. Tests on cement, aggregates, and mixes will be performed to ensure conformance with specified requirements.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify compacted aggregate base is acceptable and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Verify catch basin grates and frames and manhole castings are installed in correct position and elevation.

### **3.2 SUBBASE**

- A. Aggregate base: Install as specified in Section 32 11 23.

### **3.3 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement.
- C. Notify Engineer minimum 48 hours prior to commencement of concreting operations.

### **3.4 FORMING**

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

### **3.5 REINFORCEMENT**

- A. Place reinforcement and dowels as indicated on details in the Plans.

### **3.6 PLACING CONCRETE**

- A. Place concrete curb and gutter in accordance with MnDOT Standard Specification for Construction – 2016 Edition, Section 2531.
- B. Place concrete sidewalks in accordance with MnDOT Standard Specification for Construction – 2016 Edition, Section 2521.
- C. Place concrete pavement in accordance with MnDOT Standard Specification for Construction - 2016 Edition, Section 2301.
- D. The EJCDC General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code or instruction.
- E. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
- F. Place concrete continuously over the full width of the panel and between predetermined construction joints.



- G. Do not break or interrupt successive pours such that cold joints occur.

### **3.7 JOINTS**

- A. Place expansion joints as shown on details in the Plans. Align curb, gutter, and sidewalk joints.
- B. Provide scored or sawn joints between sidewalks and curbs and between curbs and pavement as shown on details in the Plans.
- C. Provide keyed joints as indicated on details in the Plans.

### **3.8 EXPOSED AGGREGATE**

- A. Apply surface retarder where exposed aggregate finish is required.
- B. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush exposing aggregate.

### **3.9 FINISHING**

- A. Driveway Paving: Light broom, parallel to the direction of travel.
- B. Sidewalk Paving: Light broom, perpendicular to the direction of travel.
- C. Curbs and Gutters: Light broom, perpendicular to the direction of travel.
- D. Place curing compound on exposed concrete surfaces immediately after finishing.

### **3.10 TOLERANCES**

- A. Maximum Variation of Surface Flatness: 1/4 in 10 ft.
- B. Maximum Variation From True Position: 1/4 inch.

### **3.11 FIELD QUALITY CONTROL**

- A. Three concrete test cylinders will be taken for every 100 or less cubic yards of each class of concrete placed each day.
- B. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.
- C. One slump test will be taken for each set of test cylinders taken.
- D. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

### **3.12 PROTECTION**

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian or vehicular traffic over pavements, curbs and sidewalks for 5 days minimum after finishing.

**END OF SECTION**



## **SECTION 32 1723 - PAVEMENT MARKING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. This work shall consist of furnishing and applying paint on pavement surfaces, in the form of traffic lanes, parking bays, areas restricted to handicapped persons, crosswalks, and other detail pavement markings, in accordance with the details as shown or as prescribed by the Owner.

#### **1.2 SUBMITTALS**

- A. Section 01 3300 - Submittal Procedures: Requirements for submittals.
- B. In accordance with SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish Manufacturer's Certificates and Data certifying that the following materials conform to the requirements specified.

### **PART 2 PRODUCTS**

#### **2.1 PAINT**

- A. Paint for marking pavement (parking lot and zone marking) shall meet MnDot spec 3591. Owner will make color selections.

#### **2.2 PAINT APPLICATOR**

- A. Apply all marking by approved mechanical equipment. The equipment shall provide constant agitation of paint and travel at controlled speeds. Synchronize one or more paint "guns" to automatically begin and cut off paint flow in the case of skip lines. The equipment shall have manual control to apply continuous lines of varying length and marking widths as shown. Provide pneumatic spray guns for hand application of paint in areas where a mobile paint applicator cannot be used, use a separate piece of equipment. An experienced technician that is thoroughly familiar with equipment, materials, and marking layouts shall control all painting equipment and operations.

#### **2.3 SANDBLASTING EQUIPMENT**

- A. Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall furnish not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used.

### **PART 3 EXECUTION**

#### **3.1 SURFACE PREPARATION**

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.
- B. Thoroughly clean all surfaces to be marked before application of paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods. Completely remove rubber deposits, existing paint markings, and other coatings adhering to the pavement with scrapers, wire brushings, sandblasting, mechanical abrasion, or approved chemicals.

### **3.2 APPLICATION**

- A. Apply uniformly painted pavement marking of required color(s), length, and width with true, sharp edges and ends on properly cured, prepared, and dried surfaces in conformance with the details as shown and established control points. The length and width of lines shall conform within a tolerance of plus or minus 3 inches and plus or minus 1/8 inch, respectively, in the case of skip markings. The length of intervals shall not exceed the line length tolerance. Temperature of the surface to be painted and the atmosphere shall be above 50°F and less than 95°F. Apply the paint at a wet film thickness of 0.015 inch. Apply paint in one coat. Markings showing light spots may receive additional coats. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of asphalt, and pick-up, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the marking, discontinue paint operations until cause of the slow drying is determined and corrected. Remove and replace marking that is applied at less than minimum material rates; deviates from true alignment; exceeds stipulated length and width tolerances; or shows light spots, smears, or other deficiencies or irregularities. Use carefully controlled sand blasting, approved grinding equipment, or other approved method to remove marking so that the surface to which the marking was applied will not be damaged.

### **3.3 PROTECTION**

- A. Conduct operations in such a manner that necessary traffic can move without hindrance. Protect the newly painted markings so that, insofar as possible, the tires of passing vehicles will not pick up paint. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic. Efface and replace damaged portions of markings at no additional cost to the Owner.

### **3.4 DETAIL PAVEMENT MARKING**

- A. Use Detail Pavement Markings, exclusive of actual traffic lane marking, at exit and entrance islands and turnouts, on curbs, at crosswalks, at parking bays, and at such other locations as shown. Show the International Handicapped Symbol at indicated parking spaces. Color shall be selected by owner. Apply paint for the symbol using a suitable template that will provide a pavement marking with true, sharp edges and ends. Place detail pavement markings of the color(s), width(s) and length(s), and design pattern at the locations shown.

### **3.5 FINAL CLEAN-UP**

- A. Remove all debris, rubbish and excess material from the Station.

**END OF SECTION**

## **SECTION 32 5800 LANDSCAPING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Final Grading
  - 2. Fertilizer
  - 3. Sod
  - 4. Seed
  - 5. Mulch
  - 6. Hydro-mulch

#### **1.2 SUBMITTALS**

- A. Furnish the Engineer with the Supplier's or Manufacturer's product specification data or testing results stating the materials furnished meet the requirements of the specifications.
- B. Furnish the Engineer with a certificate of compliance stating the species, sizes, quantities furnished, and nursery supplier.

#### **1.3 REFERENCES**

- A. Minnesota Department of Transportation (MN/DOT) 2016 Edition
  - 1. Section 2574, Soil Preparation
  - 2. Section 2575, Establishing Turf and Controlling Erosion
  - 3. Section 3876, Seed
  - 4. Section 3877, Topsoil Borrow
  - 5. Section 3878, Sod
  - 6. Section 3881, Commercial Fertilizer
  - 7. Section 3882, Mulch Material
  - 8. Section 3884, Hydraulic Soil Stabilizer (Hydro-mulch)
- B. Minnesota Department of Transportation (MN/DOT) District Seeding Recommendations.
- C. ANSI Z60, American Standard for Nursery Stock

#### **1.4 WARRANTY**

- A. All material shall be guaranteed by the Contractor to be in good, healthy, and vigorous conditions of active growth typical of the species for a period of one full year following the date of the final inspection.
- B. Material that at any time during the guarantee period dies or is in obviously declining condition shall be removed immediately and replaced as soon as favorable conditions exist.
- C. At the end of the guarantee period, replace material that, in the opinion of the Engineer or Owner, is in an unhealthy or unsightly condition. Remove rejected materials from the site and replace as originally specified.

### **PART 2 PRODUCTS**

#### **2.1 FERTILIZER**

- A. Fertilizers shall be applied at a rate determined by the seed or sod supplier. The type of fertilizer shall be determined based on the type and properties of the topsoil, seed or sod.
- B. The Contractor shall apply the fertilizers until the turf has been established, i.e. until all seeded areas have developed into turf or all new sod areas have developed a sound root structure.
- C. Once the turf has been established and accepted by the Engineer and Owner, the Owner will be responsible for further fertilizing of the landscaped areas.

## **2.2 SOD**

- A. Lawn and boulevard sod shall consist of densely rooted Kentucky bluegrass. The sod shall have a minimum of 3 varieties of Kentucky Bluegrasses. The sod shall have a lush appearance, uniform texture, and bright color throughout, weed free, containing no more than 1/4 inch of thatch over the base soil. At least two thirds (2/3) of the grasses, as determined by initial seeding proportions, shall be of acceptable improved type Kentucky bluegrass varieties. Acceptable varieties include Adelphi, Monopoly, Aspen, American Baron, Glade, Columbia, Eclipse, Fylking, Touchtown, Merit, Nassau, Midnite, and Victa.
- B. Sod furnished shall be in acceptable condition upon delivery to the site. Sod strips shall not have dry or dead edges and shall not be cut more than 24 hours in advance of delivery. The grass height of the delivered sod shall not exceed 2 inches. Deliver and unload sod the same day it is loaded on the delivery unit.

## **2.3 SEED**

- A. State-certified seed of the latest season's crop. Deliver in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures, purity, germination, weed and seed content, and inert material. Label the packages in conformance with the U.S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. On-site seed mixing shall be done only in the presence of the Engineer.
- B. B. The origin shall be clearly identified on the seed label for all seed types, including native forbs.
- C. The seed mix or species to be furnished and used shall be a uniform blend as stated in MN/DOT Section 3876 and the 2016 District Seeding Recommendations. Seed mixtures 25-151 can be used in lawn areas. Seed mixture 25-121 can be used for temporary stabilization of slopes and grading areas during construction.

- D. Protect the seed from moisture from the time of delivery until the time it is used. Wet or moldy seed shall not be used.

## **2.4 HYDROMULCH**

- A. MN/DOT 3884 Type 5 Mulch: Shall consist of wood cellulose fibers that shall contain no germination or growth inhibiting factors. It shall not contain sawdust or pulverized newspaper. It shall be dyed a color that allows for visual monitoring of its application. It shall contain 2.5 to 5.0 percent tackifiers (Type I) by weight. The moisture content shall not exceed 15% at the time of delivery. When washed on a #20 sieve at least 50 percent shall be retained.

## **2.5 WATER**

- A. Potable (or as otherwise approved) and suitable for plant growth.

## **PART 3 EXECUTION**

### **3.1 FINISH GRADING**

- A. Verify subgrade and trench backfilling have been inspected.
- B. Verify subgrade has been contoured and compacted.
- C. Where topsoil is to be placed, scarify surface to depth of 4 inches
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 6 inches.
- E. Place topsoil in areas where seeding, sod, and planting are indicated.
- F. Place topsoil to a minimum of 4" compacted thickness.
- G. Place topsoil during dry weather.
- H. Remove roots, weeds, rocks, and foreign material while spreading and prior to seeding or sod placement.
- I. Near plants spread topsoil manually to prevent damage.
- J. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- K. Lightly compact placed topsoil.

### **3.2 SOIL PREPARATION**

- A. Immediately prior to placing the topsoil, scarify the existing soils to a minimum depth of 6 inches for all areas on slopes shallower than 2 horizontal to 1 vertical.
- B. Perform soil preparation immediately prior to seeding or placing sod to prevent undesirable weed growth or soil erosion.
- C. Place the topsoil and spread uniformly over lawn areas to a minimum depth of 4 inches, unless a specific depth is stated elsewhere. Firm and smooth the topsoil after working the soil.
- D. Apply a starter fertilizer at the Manufacturer's or Supplier's recommended rates and work into the topsoil. The lag time between seeding or placing sod and fertilizing shall not exceed 48 hours.

- E. Rake the surface until it is smooth and of uniform fine texture immediately prior to seeding or placing sod.

### **3.3 SOD PLACEMENT**

- A. Carefully place the sod strips beginning at the bottom of the slope and progressing upward. Place the sod strips with staggered end joints without stretching. Tightly about the joints between the sod strips.
- B. Immediately after completing the sod placement, water and compress the sod into the underlying soil by rolling or tamping. The initial watering and rolling or tamping shall be sufficient to provide a firm contact and bond between the sod and the underlying soil. The sod surface shall be level and smooth, free of humps and depressions.
- C. Remove and dispose of waste sod, stones or other debris removed from the sodded area(s), at completion of the sod placement.
- D. Sod placed under the Contract shall be fertilized and copiously watered and maintained by the Contractor for a period of 30 days after placement or until accepted by the Owner, whichever comes first. Sod should be uniformly rooted over all areas.

### **3.4 SEEDING**

- A. The seed mixture shall be placed with a seed drill that will accurately meter the types of seed to be planted and keep all seeds uniformly mixed during drilling. The application rate for seed mixes 25-151 shall be 120 lbs/acre. The application rate for seed mix 25-151 shall be 61 lbs/acre. The drill shall be equipped with disk furrow openers and packer assembly to compact the soil directly over the drill row. Seeding shall be done at a right angle to the surface drainage. The seeding shall be done with two passes over the entire area, with the second pass in a direction at a right angle to the first pass.
- B. Seeded areas shall have the seedbed firmed after seeding and prior to mulching. Soil firming shall be done with a drag cultipacker or other approved soil firming equipment. On slopes too steep to operate mechanical equipment, the seed shall be covered by hand raking or other approved means, wherever feasible, prior to mulching. Accomplish the soil firming or seed covering immediately after seeding.
- C. The mulch shall be spread by mechanical means to provide a uniform distribution at an application rate of 2.0 tons/acre of MN/DOT Type 3 Mulch.
- D. Seed placed under the Contract shall be fertilized and watered and maintained by the Contractor for a period of 30 days after placement or until accepted by the Owner, whichever comes first. The seed shall develop into a lush turf over the landscaped areas to be acceptable.

### **3.5 HYDROSEEDING**

- A. Mix the seed, fertilizer, and mulch material in the required amount of water to produce a slurry mixture.
- B. Type 5 Hydromulch
  - 1. Seed mixture 100 lbs/acre
  - 2. Mulch 2,500 lbs/acre or 100% coverage



- C. Incorporate the mulch into the slurry mix after the seed and fertilizer have been thoroughly mixed.
- D. Direct the spray during the application to obtain a uniform material distribution.
- E. Empty the slurry mixture within one hour after the seed is added to the tank.
- F. Hydroseed placed under the Contract shall be fertilized, watered and maintained by the Contractor for a period of 30 days after placement. The seed shall develop into a lush turf over the landscaped areas to be acceptable.

### **3.6 PROTECTION AND CLEANING**

- A. Keep the pavements clean and the work area in an orderly condition during landscaping work.
- B. Protect the landscape work and materials from damage due to landscape operations or by other Contractors and trades, and trespassers. Maintain the protection measures during the installation and maintenance periods.

**END OF SECTION**



# SECTION 33 1116 - WATER UTILITY DISTRIBUTION PIPING

## PART 1 GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Watermain pipe.
  - 2. Gate Valves.
  - 3. Ductile Iron Fittings.
  - 4. Thrust Blocking.
  - 5. Tracer Wire & Test Stations.
  
- B. Related Sections:
  - 1. Section 31 23 17 - Trenching

### 1.2 SUBMITTALS

- A. Product Data: Submit data on pipe materials, pipe fittings and accessories.
- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- C. Record Drawings: Submit record drawings in accordance with General Conditions.

### 1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and ties of piping mains, fittings, corporation stops, curb stops, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store pipes in shipping containers with labeling in place until ready for use.

## PART 2 PRODUCTS

### 2.1 WATER SERVICE PIPE & FITTINGS

- A. PVC watermain pipe shall be manufactured in accordance with the requirements of AWWA C900; be PVC Class 150, DR18; and be resistant to aggressive soils or corrosive substances in accordance with the requirements of ASTM D-543.
- B. Directionally bored watermain shall be fusible C-900 PVC pipe DR-18 with a pressure rating of 235 psi and shall conform with AWWA C900-07
- C. Ductile Iron Fittings shall be mechanical joint ductile iron Class 350 conforming to the requirements of AWWA C110 or C153, ANSI A21.53, A21.11, and A21.4; shall have an asphaltic coating at least one mil thick on all exterior surfaces;

- D. Ductile Iron Fitting gaskets shall be designed and constructed to meet or exceed the requirements of AWWA C111.
- E. Ductile Iron Fitting restrainer glands shall be Megalug of approved equal.
- F. Stainless steel or Cor-Blue bolts shall be used for all ductile iron fitting connections.
- G. Gate valves shall meet the requirements of AWWA C509-80; be single disc type with resilient seat bonded with a water working pressure of not less than 150 psi; be provided with a two-inch square operating nut, painted white, opening counterclockwise; and include a stationary valve rod extension which attaches to the operating nut and extends to within 1' of the valve box cover.
- H. Valve boxes shall be three piece, 5 ¼", screw type for a burial depth of 8' or as shown on the plans and be of sufficient length to provide for minimum adjustment of 6" above and below grades when the pipe is installed to specified depth.
- I. Hydrants shall conform to the applicable requirements of AWWA C502; be Waterous WB-67 Pacer or Engineer approved equal; have 16" from the breakaway flange to the discharge fittings; match sizes and type of thread with City fire department (Two hose nozzles, one pumper nozzle); be provided with outlets for drainage in the base or barrel; be rotated counterclockwise to open.
- J. Hydrant restrainer glands shall be Megalug of approved equal.

## **2.2 TRACER WIRE**

- A. Tracer wire shall be #12 AWG copper-clad steel wire with 30 mils of blue HDPE coating.
- B. Tracer wire shall be spliced using a direct bury splice kit and be covered with a flame retardant compound.
- C. Tracer wire test stations shall be Rhino TriView Flex Test Station, Carsonite Perma-Post Test Station or Engineer approved equal.
- D. Tracer wire test stations shall be 72" tall, blue in color, with two internal terminals and water pipeline stickers affixed to them.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Execution shall be in accordance with ASTM D2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications", AWWA C600, "AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances", AWWA Standard 605, "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water" and as shown in the plans except as modified herein.

- B. The installation of directionally bored water lines shall be as performed in accordance with the requirements of the Minnesota Department of Transportation, NUCA HDD Installation Guidelines, and ASTM F1962.
- C. When replacing existing watermain and services, the existing water supply must remain active during construction. The Contractor shall make the necessary arrangements to provide uninterrupted water service to all properties adjacent to the project.

### **3.2 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify municipal utility sewer main size, location, and invert are as indicated on Drawings.

### **3.3 PREPARATION**

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

### **3.4 EXCAVATION, TRENCHING & BEDDING**

- A. Excavate pipe trench in accordance with Section 31 23 17 for the work of this section.
- B. Granular bedding material and encasements are required as indicated in the plans.
- C. In wet or unsuitable soil conditions, the Contractor shall excavate 6" below the bottom of the pipe, furnish and install a 6" crushed rock foundation to provide support for the pipe installation.

### **3.5 WATER PIPING**

- A. Maintain separation of water main from sanitary sewer and storm sewer of 10 feet in accordance with Minnesota Department of Health requirements.
- B. When crossing sanitary sewer mains our services, a minimum of 18" of vertical separation shall be provided. One full length of water pipe shall be centered at the point of crossing so both joints will be equidistant and as far from the sewer as possible.
- C. Have sufficient materials available to allow for unknown conditions that may be encountered.
- D. Have sufficient tools on-site that may be necessary during construction of the watermain; such as, valve box brenches, curb stop wrenches, gate valve keys, etc.
- E. Install pipe to indicated elevation to within tolerance of 1/2 inches.

- F. Establish elevations of buried piping with not less than 8ft of cover without polystyrene insulation.
- G. When using a bar to push the watermain pipe home, wood blocking shall be used to protect the bell or spigot of the pipe from being damaged.
- H. Install concrete for thrust restraints at each elbow or change of direction of pipe main and as shown in the plans.
- I. Support blocking, reaction blocking and anchorage devices shall be provided as detailed in the plans.
- J. Excavations shall not be backfilled until fittings and connections have been inspected by the Owner or the Engineer.
- K. Excavations shall not be backfilled until necessary information for record drawings has been recorded.

### **3.6 FITTINGS**

- A. All plugs, caps, tees, bends and other thrust points shall be provided with reaction backing, or movement shall be prevented by attachment of suitable restraining devices, megalugs or tie rods in accordance with plans.
- B. Fittings shall be protected with an 8-mil polyethylene encasement in accordance with ANSI/AWWA C105/A21.5-88.

### **3.7 TRACER WIRE**

- A. Tracer wire shall be attached to the top and in the center of the pipe as necessary such that the wire is not displaced during backfilling operations.
- B. Tracer wire shall be brought to the surface as shown in the plans at the end of the main, at each valve box, at each hydrant, and shall be connected to existing tracer wire when connecting to an existing main.
- C. Sufficient tracer wire shall be left around curb stop to allow for extension of the tracer wire to the residence with the extension of the water service.
- D. Tracer wire test stations shall be connected to the tracer wire and installed at every hydrant.

### **3.8 DIRECTIONAL BORING**

- A. The installation of directionally bored water lines shall be as performed in accordance with the requirements of the Minnesota Department of Transportation, NUCA HDD Installation Guidelines, and ASTM F1962.
- B. Excavate pipe trench and jacking pits in accordance with Section 02324 - Trenching for the work of this section.

- C. Granular bedding material and encasements are required as indicated in the plans.
- D. In wet or unsuitable soil conditions, the Contractor shall excavate 6" below the bottom of the pipe, furnish and install a 6" crushed rock foundation to provide support for the pipe installation.
- E. Follow permit requirements for traffic control and excavation protection.
- F. Directional boring shall be completed by an experienced contractor who can demonstrate expertise in trenchless methods and provide a list of three references of project of similar nature constructed in the last two years.
- G. The equipment must be remotely steerable and permit electronic monitoring of tunnel depth and location. The system must be able to control the depth and direction of the pipe and must be accurate to a window of 1.5 inches  $\pm$ . The system must utilize a fluid cutting process using a liquid clay or bentonite. The drilling fluid must be inert and contain no risk to the environment. The liquid clay or bentonite shall remain in the tunnel to stabilize the tunnel wall and provide a lubricant to reduce frictional drag when the pipe is installed.
- H. Tracer wire shall be installed with every pipe that is directionally bored.
- I. Excavations shall not be backfilled until connections have been inspected by the Owner or the Engineer.
- J. Excavations shall not be backfilled until necessary information for record drawings has been recorded.
- K. The Contractor shall install concrete Jersey barriers on each side of the roadway adjacent to the boring pit excavation prior to any excavation. This work shall conform to Appendix B MNDOT Traffic Control for Short Term Street or Highway Work Zones, as shall all other required traffic control measures.
- L. At the directional boring pit and/or receiving pit, the Contractor shall provide protection around the open trench in the form of snow fencing supported with adequate steel fence posts at ten-foot intervals. This protection shall be established completely around the pit and shall remain in place until the entire construction activities are completed and the pits backfilled.
- M. Excavated material shall be protected from erosion into existing utilities and surrounding areas. Material shall be protected using the Minnesota Pollution Control Agency -Inspector's Guide for Erosion and Sediment Control guide and follow any and all MPCA rules governing erosion control.
- N. There shall be a shield or an equivalent method to control the flow of materials from the excavation.

- O. The Contractor shall implement dewatering techniques to prevent surface water and subsurface or groundwater from flowing into boring pit excavations and/or to accumulate in excavations.

### **3.9 DISINFECTION**

- A. Before being placed into service, the completed watermain shall be disinfected and tested in accordance with 3.10B of this specification section.
- B. Where an existing watermain is cut for the installation of any fitting, the pipe and fittings proposed to be installed shall be disinfected prior to installation as follows:
  - 1. The interior of the pipe and fittings shall be cleaned of all dirt and foreign material.
  - 2. The interior of the pipe and fittings shall be thoroughly swabbed or sprayed with a 1 percent minimum hypochlorite solution or another method approved by the Engineer.

### **3.10 FIELD QUALITY CONTROL**

- A. Bacteria Testing
  - 1. After the final flushing, the water shall be tested for bacteriologic quality and found to meet the standards prescribed by the Minnesota Department of Health.
- B. Electric Conductivity Test
  - 1. All tracer wire shall be tested for electrical conductivity from tracer wire test station to tracer wire test station.
- C. Hydrostatic Testing
  - 1. After the watermain installation is complete, including all fittings and valves and hydrants, all newly-constructed pipe shall be subject to hydrostatic pressure of 150 psi for a duration of at least two hours.
  - 2. Each section to be tested shall be filled with water and all air expelled at the highest point. The required taps to expel air or to fill the watermain shall be supplied and installed by the Contractor and shall be ¾" and shall include an approved service saddle.
  - 3. For a passing test, the hydrostatic pressure cannot drop more than 2 psi during the last hour of the two hour pressure test. If this requirement cannot be met, the Contractor shall investigate the cause, make corrections and retest until the pressure drop requirement can be met.
- D. Any portion of the work deemed to be defective through the testing shall be remedied at no additional cost to the Owner.
- E. Owner or Engineer shall be present for all testing for verification of results.
- F. The Owner will not consider final acceptance or substantial completion until all testing and corrective action is completed to the satisfaction of the Engineer.



**3.11 PROTECTION OF FINISHED WORK**

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

**END OF SECTION**



## **SECTION 33 3000 SANITARY SEWERAGE UTILITIES**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Sanitary sewer main pipe.
  - 2. Sanitary sewer service pipe.
  - 3. Sanitary sewer manholes.
- B. Related Sections:
  - 1. Section 31 23 17 – Trenching.

#### **1.2 SUBMITTALS**

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe materials, pipe fittings and accessories.
- C. Shop Drawings: Submit shop drawings of the sanitary sewer manholes to the Engineer for review prior to fabrication.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- E. Record Drawings: Submit record drawings in accordance with Section 01 3300.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Section 01 70 00 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations and ties of piping mains, manholes, wyes, service cleanouts, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver and store pipes in shipping containers with labeling in place until ready for use.
- C. Deliver and store manhole within project site. Where applicable, manholes shall be stored on the backslopes of any ditches.

### **PART 2 PRODUCTS**

#### **2.1 SANITARY SEWER MAIN PIPE**

- A. All PVC pipe and fittings shall be manufactured in accordance with the requirements of ASTM D-3034, "Standard Specification for PVC Sewer Pipe and Fittings" or ASTM F-679, "Standard Specification for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings".
- B. All PVC pipe joints shall be gasketed, bell and spigot, push-on type conforming to ASTM D3212, "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals".

- C. Sanitary sewer main pipe shall be PVC SDR35.
- D. Sanitary sewer main fittings shall be PVC SDR26.

## **2.2 SANITARY SEWER MANHOLE**

- A. Precast concrete riser sections and appurtenant units (grade rings, top and base slabs, special sections, etc.) used in the construction shall conform to the requirements of ASTM C-478, MnDOT 2506, MnDOT 3622 and as shown in the plans except as modified herein.
- B. All manholes shall have sealed "boots" cast in the manhole for all pipe connections.
- C. Manhole steps shall conform to MnDOT Standard Plate 4180 and shall be made of reinforced plastic.
- D. Sanitary sewer manhole castings shall be gray iron or ductile iron capable of withstanding traffic loadings and conform to MnDOT Standard Plate 4101 for a 7" casting No. 700-7.
- E. Castings shall be marked "Sanitary Sewer" on the lid. Lids shall be sealed type with neoprene seal and pick hole shall be recessed.

## **2.3 COMPOSITE UTILITY ID POST**

- A. Composite utility ID posts installed by manholes outside of roadways or alleys shall be manufactured by Carsonite, Rhino, or Engineer approved equal.
- B. Utility ID posts shall be Sewer Green in the uniform APWA color coding scheme or approved equal.

## **2.4 PRECAST JOINT EXTERNAL SEAL WRAP**

- A. Precast joint external seal wrap shall be an 8" single continuous rubber band made of EPDM rubber with a minimum thickness of 65 mils.
- B. The seal shall be secured by a 2" wide mastic strip on the top and bottom edge of the rubber wrap.
- C. The mastic shall be non-hardening butyl rubber sealant and shall adhere to two different manhole sections.

## **2.5 EXTERNAL RUBBER SEALING SLEEVE**

- A. External chimney seals shall be a single continuous rubber band made of EPDM rubber with a minimum thickness of 65 mils.
- B. The seal shall be secured by a 2" x ¼" mastic strip on the top and bottom edge.
- C. The mastic shall be non-hardening butyl rubber sealant and shall seal the cone/top slab of the manhole and over the lip of the casting.

## **2.6 SANITARY SEWER SERVICES**

- A. All PVC pipe and fittings shall be manufactured in accordance with the requirements of ASTM D-3034, "Standard Specification for PVC Sewer Pipe and Fittings" or ASTM F-679, "Standard Specification for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings".
- B. All PVC pipe joints shall be gasketed, bell and spigot, push-on type conforming to ASTM D3212, "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals".

- C. Sanitary sewer service pipe and fittings shall be PVC SDR 26 unless otherwise shown on the plans.

### **PART 3 EXECUTION**

#### **3.1 GENERAL**

- A. Execution shall be in accordance with ASTM D2321, "Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications", National Precast Concrete Association's "NPCA Manhole Installation Guide", and as shown in the plans except as modified herein.
- B. The NPCA Manhole Installation Guide is available at [http://www.precast.org/manhole/Rec\\_Manhole/Install\\_Procedures.pdf](http://www.precast.org/manhole/Rec_Manhole/Install_Procedures.pdf)
- C. Existing lines and wastewater flow must remain active during construction. The Contractor shall make the necessary arrangements to provide uninterrupted sanitary sewer service to all properties adjacent to the project.

#### **3.2 EXAMINATION**

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify municipal utility sewer size, location, and invert are as indicated on Drawings.

#### **3.3 EXCAVATION, TRENCHING & BEDDING**

- A. Excavate for manhole and pipe trench in accordance with Section 31 23 17 – Trenching for the work of this section.
- B. Granular bedding material and encasements are required as indicated in the plans.
- C. In wet or unsuitable soil conditions, the Contractor shall excavate 6" below the bottom of the pipe, furnish and install a 6" crushed rock foundation to provide support for the pipe installation.

#### **3.4 SANITARY SEWER MAIN**

- A. Maintain separation of water main from sanitary sewer and storm sewer of 10 feet in accordance with Minnesota Department of Health requirements.
- B. Have sufficient materials available to allow for unknown conditions that may be encountered.
- C. When using a bar to push the sanitary sewer pipe home, wood blocking shall be used to protect the bell or spigot of the pipe from being damaged.
- D. Install pipe to indicated elevation to within tolerance of 1/2 inches.

#### **3.5 SANITARY SEWER MANHOLE**

- A. All manholes shall be constructed with 0.10' of elevation drop from all inlets to the outlets unless otherwise specified on the plans.
- B. Manholes placed in bituminous pavement or concrete pavement shall be ½" below the finished road or driveway surface.
- C. Manholes placed in gravel surfaces shall be ½" below the finished road or driveway surface.

- D. Manholes placed in turf areas shall be flush with the finished grade of the surrounding ground.
- E. All manholes placed outside of roadways or alleys shall have a composite utility ID post.
- F. Every joint on every manhole shall be sealed with an external rubber sealing sleeve and a precast joint external seal wrap to prevent leakage into the manhole.

### **3.6 SANITARY SEWER SERVICES**

- A. All service fittings, including wyes, bend, and cleanouts, shall have 1 ½" crushed or natural rock as foundation material.
- B. Cleanouts shall be extended to within 6 inches of finished grade elevation.
- C. When using a bar to push the sanitary sewer pipe home, wood blocking shall be used to protect the bell or spigot of the pipe from being damaged.
- D. Excavations shall not be backfilled until connections have been inspected by the Owner or the Engineer.
- E. Excavations shall not be backfilled until necessary information for record drawings has been recorded.

### **3.7 FIELD QUALITY CONTROL**

- A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.
- B. Deflection Testing
  - 1. Shall be performed on all plastic gravity sewer pipes 8 inches in diameter or larger.
  - 2. Shall be conducted after the sewer trench has been backfilled to the desired finished grade and has been in place for 30 days.
  - 3. Shall be performed by pulling a rigid ball or nine-point mandrel through the pipe without the aid of mechanical pulling devices.
  - 4. The ball or mandrel shall have a minimum diameter equal to 95% of the actual inside diameter of the pipe.
  - 5. Test will be considered acceptable if the mandrel can progress throughout the entire line without binding.
- C. Upon completion of air and deflection testing, all sanitary sewer pipe 8 inches in diameter or larger shall be jetted and televised prior to final acceptance and system startup.
- D. Upon completion of jetting the sanitary sewer main, all sanitary sewer manholes shall be cleaned prior to final acceptance and system startup.
- E. Any portion of the work deemed to be defective through the testing shall be remedied at no additional cost to the Owner.
- F. Owner or Engineer shall be present for all testing for verification of results.
- G. The Owner will not consider final acceptance or substantial completion until all testing, jetting, and corrective action is completed to the satisfaction of the Engineer.

### **3.8 PROTECTION OF FINISHED WORK**

- A. Section 01 70 00 - Execution Requirements: Requirements for protecting finished Work.

- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

**END OF SECTION**





## **SECTION 33 4000 STORM DRAINAGE UTILITIES**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. PVC pipe sewer.
  - 2. RCP pipe sewer.
  - 3. HDPE pipe sewer.
  - 4. Concrete Manholes and Catch Basins.
  - 5. Riprap.
- B. Related Sections
  - 1. Section 31 23 17 – Trenching.
  - 2. Section 31 25 13 – Erosion Controls.

#### **1.2 SUBMITTALS**

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on pipe, fittings and accessories.'
- C. Shop Drawings: Submit shop drawings of the storm sewer structures to the Engineer for review prior to fabrication.
- D. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Section 01 70 00 - Execution Requirements: Requirements for submittals.
- B. Project Record Documents:
  - 1. Accurately record actual locations of pipe runs, connections, and invert elevations.
  - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- C. Operation and Maintenance Data: Procedures for submittals.

#### **1.4 QUALITY ASSURANCE**

- A. Furnish each aggregate material from single source throughout the Work.

### **PART 2 PRODUCTS**

#### **2.1 GENERAL**

- A. Materials shall be in accordance with MnDOT Standard Specification for Construction – 2016 Edition, Section 2501, 2503, 2506 and 2511.

#### **2.2 CONCRETE PIPE SEWER**

- A. Reinforced Circular Concrete Pipe
  - 1. Meeting requirements of MnDOT 3236.
  - 2. As per MnDOT Standard Plate 3000.
  - 3. Pipe less than 30" diameter shall be Class III.

- B. Pipe Joints
  - 1. Bell and spigot end joints.
  - 2. Rubber gasketed to meet the requirements of MnDOT 3726 (MnDOT Standard Plate 3006).
- C. Aprons
  - 1. As per MnDOT Standard Plate 3100G.
  - 2. Three sections preceding an apron and the apron itself shall be tied in accordance with MnDOT requirements.

### **2.3 PVC STORM SEWER PIPE**

- A. All PVC pipe and fittings shall be manufactured in accordance with the requirements of ASTM D-3034, "Standard Specification for PVC Sewer Pipe and Fittings" or ASTM F-679, "Standard Specification for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings".
- B. All PVC pipe joints shall be gasketed, bell and spigot, push-on type conforming to ASTM D3212, "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals".
- C. Storm sewer main pipe shall be PVC DR 35.

### **2.4 MANHOLES AND CATCH BASINS**

- A. Shall be pre-cast concrete meeting the requirements of ASTM Specification C-478 and MnDOT 2506.
- B. Manholes and catch basins shall conform to MnDOT Standard Plate 4003, 4005, or 4006 as applicable by the design designated on the plans.
- C. All joints shall be gasketed.

### **2.5 RIPRAP**

- A. Shall be random riprap, Class III meeting the requirements of MnDOT 3601.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Execution shall be as specified in the MnDOT Standard Specifications for Construction – 2016 Edition, Section 2501 and 2511.
- B. The General and Supplemental specifications shall take precedence in resolving any conflict, error, etc. between the Contract Documents and any standard, specification, manual, code, or instruction.

### **3.2 EXAMINATION**

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify municipal utility sewer main size, location, and inverts are as indicated on Drawings.
- C. Do not place riprap bags over frozen or spongy subgrade surfaces.

### **3.3 EXCAVATION, TRENCHING & BEDDING**

- A. Excavate pipe trench in accordance with Section 31 23 17 – Trenching for the work of this section.
- B. Granular bedding material and encasements are required as indicated in the plans.
- C. In wet or unsuitable soil conditions, the Contractor shall excavate 6” below the bottom of the pipe, furnish and install a 6” crushed rock foundation to provide support for the pipe installation.
- D. The Contractor shall not impede existing drainage ways during construction, if necessary, the Contractor shall temporarily bypass until permanent measures are operational.

### **3.4 PREPARATION**

- A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

### **3.5 PIPE SEWERS AND CULVERTS**

- A. All culverts or pipe sewers to be removed or salvaged and reinstalled shall be replaced at the same location and elevation unless otherwise shown on the plans.
- B. All existing pipe sewers or culverts are to remain in place if possible unless otherwise shown on the plans.

### **3.6 PROTECTION OF INSTALLED CONSTRUCTION**

- A. Section 01 70 00 - Execution Requirements: Protecting installed construction.
- B. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

**END OF SECTION**



## **SECTION 33 4600 - SUBDRAINAGE**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Building Perimeter Drainage Systems.
- B. Filter aggregate and fabric and bedding.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 31 2316 - Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- B. Section 31 2323 - Fill: Backfilling over filter aggregate, up to subgrade elevation.

#### **1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe drainage products and pipe accessories.
- C. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections.

### **PART 2 PRODUCTS**

#### **2.01 PIPE MATERIALS**

- A. Corrugated Plastic Tubing: Flexible type; 4 inch (100 mm) diameter, with required fittings.
- B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

#### **2.02 AGGREGATE AND BEDDING**

- A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 31 2323.

#### **2.03 ACCESSORIES**

- A. Pipe Couplings: Solid plastic.
- B. Filter Fabric: Water pervious type, black polyolefin.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout Drawings.

### **3.02 PREPARATION**

- A. Hand trim excavations to required elevations. Correct over-excavation with material as indicated in Section 31 2323.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

### **3.03 INSTALLATION**

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place drainage pipe on clean cut subsoil.
- C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 10 feet (3 m).
- D. Place pipe with perforations facing down. Mechanically join pipe ends.
- E. Install pipe couplings.
- F. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches (300 mm).
- G. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.
- H. Place aggregate in maximum 4 inch (100 mm) lifts, consolidating each lift.
- I. Refer to Section 31 2323 for compaction requirements. Do not displace or damage pipe when compacting.
- J. Place impervious fill over drainage pipe aggregate cover and compact.

### **3.04 PROTECTION**

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

## **END OF SECTION**