

**Part 1. Request for Bids**

**Part 2. Schedule**

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**Part 6. Technical Specifications**

**Part 1 - Request for Bids**  
**Multiuse Field Improvements at Platte Ridge Park**

The Platte County Commission is seeking bids for Multiuse Field Improvements at Platte Ridge Park.

Sealed bids for Multiuse Field Improvements at Platte Ridge Park located at 17130 MY HWY 371, Platte City, MO 64079 will be received from qualified bidders at the office of the County Clerk, Room 116, 415 Third Street, Platte City, MO until Wednesday, May 25th at 9:00 A.M. following which they will be publicly opened and read. Please submit two original and signed copies of your bid. Bids received after the designated closing time will be returned unopened.

Contractors seeking the bid specification packet should contact Chris Oryshyn, Assistant Director, Parks and Recreation Department, at 816.858.3337 or at [coryshyn@co.platte.mo.us](mailto:coryshyn@co.platte.mo.us).

A pre-bid meeting will be held Friday May 6th, 2022 at 1:00 PM. at McClure Engineering, 1700 Swift Street, Suite 100, North Kansas City, MO 64116.

The County Commission reserves the right to reject any and all bids, to waive any informalities, and accept the best submitted bid in the sole discretion of the County.

Done this **18th** Day of **April**, 2022 at Platte City, Missouri:

**Part 2 - Schedule**  
**Multiuse Field Improvements at Platte Ridge Park**

April 18, 2022	Request for Bids
April 19, 2022	Request for Bids Advertised
May 6, 2022	Pre-bid Meeting
May 25, 2022	Bids Due at 9:00 AM at Office of County Clerk
June 6, 2022	Bid Award/Contract Approval/Notice to Proceed

**Part 3 – General Specifications**  
**Multiuse Field Improvements at Platte Ridge Park**

**1) GENERAL REQUIREMENTS**

Platte County, Missouri is requesting bids from qualified contractors for Multiuse Field Improvements at Platte Ridge Park.

- a) This request describes the technical specifications for the materials and services to be performed and contains an overview of the terms under which materials and services are to be provided.
- b) Successful contractor shall indemnify and hold the County harmless from any claims for damages or loss of any kind whatsoever arising from the performance of responsibilities under this request.
- c) Successful contractor shall comply with all federal, state and local laws, safety and health standards and rules and regulations, including but not limited to the Occupational Safety and Health Act and Safety Standards Act with its performance of the work.
- d) The facility owner, a County of the first classification, is a political subdivision of the State of Missouri supported by public funds and covered by the sales tax exemption set forth at Section 144.062.R.S.Mo. Accordingly, all proposals shall be made without sales and use tax. Use by the contractor of any materials and equipment other than purchased as required by this procedure, unless specific written authorization has been granted by County, is prohibited and may result in termination of the agreement.
- e) Contractor shall provide proof of insurance for the following coverage levels:
  - i) Comprehensive General Liability – minimum limit of \$1,000,000 combined single limit for bodily injury and property damage per occurrence
  - ii) Workers Compensation – if applicable per statutory requirements
  - iii) Employers Liability - \$500,000 each employee, \$500,000 each accident, and \$500,000 policy limit
  - iv) Commercial Automobile Liability - \$1,000,000 combined single limit  
Excess (Umbrella Liability) - \$1,000,000

**g) BOND REQUIREMENTS**

The successful contractor shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Contractor's usual sources but shall be by a surety acceptable to the County. The cost for furnishing such bonds shall be included in the bid. The successful contractor shall deliver the required bonds to the County no later than the date of execution of the Contract.

## h) PREVAILING WAGE

The Contractor and all of its subcontractors hereby agree to the Prevailing Wage Law of the State of Missouri and shall pay all workmen in connection with this project a wage of no less than the prevailing hourly rate of wages for work of similar character in the construction of this Project. Should any Contractor fail to comply with this requirement, it shall forfeit, as a penalty to Platte County Parks and Recreation, the amount prescribed by law for each workman it employed, for each calendar day, or portion thereof, such workman is paid less than the said stipulated rates for any work done under this Contract, by it or any subcontractors under it. It is hereby agreed that Owner and Architect shall be held harmless from any claims which result in Contractor's failure to comply with these regulations. A schedule of prevailing wage rates, requirements, guidelines and regulations is available for free via:

<http://labor.mo.gov/DLS/prevailingwage/>

The Contractor/Vendor shall file with the Architect upon completion of the project, prior to final payment, the proper affidavit stating that he has fully complied with the provisions and requirements of the applicable "Prevailing Wage Law" sections. The Architect shall not approve the final Application for Payment until this affidavit is filed and is in proper form and order.

Such bonds shall name Platte County as obligee. Contractor shall be responsible for notifying its Surety (ies) of any modification to the Contract Sum and/or the Contract time and said Surety (ies) shall not seek discharge as a result of any failure on the Contractor's part to notify Surety (ies).

The Contractor shall require the Attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the Power of Attorney.

## 2) QUESTIONS, CLARIFICATIONS, SITE VISITS

- a) For questions related to these specifications or to arrange visit to the work site, contact Chris Oryshyn, Assistant Director, Platte County Parks and Recreation at 816.858.3337 or coryshyn@co.platte.mo.us.

## 3) SUBMISSION OF PROPOSALS

- a) Respondents must submit **two (2) copies** of their bids. Bids must be received no later than 9:00 A.M. on Wednesday, May 25 at the office of the County Clerk, 415 Third Street, Platte City, MO. Proposals received after this date and time will be returned unopened.
- b) Responder shall include the following in his/her proposal:
  - i) Completed and signed Bid Form (two originals)

- ii) A proposed Work Schedule (one page) - The vendor will indicate the timing of equipment deliveries and installation tasks as they apply this request.
  - iii) Company Profile (one page) – This section shall include information relating to the business organization of the contractor, any third party which would be partnering with the contractor on services, and any relevant experience.
- c) By submission of a proposal to the County, the contractor acknowledges he/she is familiar with site conditions, the materials and services to be provided and work to be performed. Any special recommendations for equivalent or non-specified equipment shall be included in vendor's proposal along with appropriate justifications.
- d) Platte County reserves the right to reject any and all proposals, waive any informalities or irregularities, and to accept the proposal that is deemed most advantageous to the County in the sole discretion of the County.

**Part 4 - Bid Form**  
**Multiuse Field Improvements at Platte Ridge Park**

The Undersigned, in compliance with the Request for Bids for the **Multiuse Field Improvements at Platte Ridge Park**, having examined the specifications and requirements and the site of the proposed work, and being familiar with all of the conditions surrounding the proposed work, including the requirements of working within a public facility, proposes to furnish labor, materials, and equipment necessary to complete the work for the price stated below. Bidder shall acknowledge any addenda for this bid. Bidder shall include project completion timeline with this bid.

**TOTAL Bid Submission for Project:**                      \$ \_\_\_\_\_

**Anticipated Completion date of project:**                      \_\_\_\_\_

Firm/Company Name: \_\_\_\_\_ Telephone: \_\_\_\_\_

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

By signature below, we hereby respectfully submit our proposal to complete the proposed work and to comply with all stated specifications, requirements, and applicable laws herein:

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed Name and Title

**Part 5 – SAMPLE Form of Agreement**  
**Multiuse Field Improvements at Platte Ridge Park**



**Platte County, Missouri**  
**AGREEMENT FOR SERVICES**

**Project:** \_\_\_\_\_

This Agreement is made this \_\_\_\_ Day of \_\_\_\_\_, 202\_, by and between  
PLATTE COUNTY, MISSOURI, hereinafter referred to as "COUNTY", and \_\_\_\_\_,  
hereinafter referred to as "CONTRACTOR".

WITNESSETH THAT:

WHEREAS the COUNTY wishes to retain the services of CONTRACTOR to  
provide, install and warrant \_\_\_\_\_ for Platte County  
\_\_\_\_\_ facilities located at \_\_\_\_\_; and

WHEREAS, CONTRACTOR wishes to provide such equipment and services to  
COUNTY as described in the referenced documents,

NOW, THEREFORE, in consideration of the mutual covenants and agreements  
set forth herein, the parties hereby agree as follows:

1. **SCOPE OF WORK.** CONTRACTOR shall perform all work  
required to be performed to provide and install \_\_\_\_\_ at  
\_\_\_\_\_ in Platte County, Missouri, as set forth in the Request  
for Bids and Specifications. Services shall include furnishing all labor, materials, necessary

tools, expendable equipment, and all transportation services required to be done for a complete system installation compatible with existing site conditions and equipment as specified.

2. **EXISTING CONDITIONS.** CONTRACTOR represents that it has examined and is familiar with the existing conditions of the facilities and equipment related to the performance of this Agreement. CONTRACTOR also represents that it has been fully informed of the contract requirements and work necessary to complete specified \_\_\_\_\_, including installation of such within existing space and harmonious with existing equipment to provide for complete and continuous operation of the entire system. CONTRACTOR shall not be relieved of any obligation under contract or entitled to additional compensation due to its failure to receive or examine any form or legal instrument or to visit the facilities and inspect the conditions existing at the facilities and the quality and condition of the equipment to be installed or relocated or if the CONTRACTOR subsequently finds that conditions require methods or equipment other than those anticipated in submitting the proposal.

3. **WARRANTY.** CONTRACTOR shall warrant all work provided pursuant to this Agreement, to specifically include all labor and materials, for a period of twelve (12) months from the date of the Agreement and to provide all repairs and labor needed to fulfill this warranty.

4. **COMPENSATION.** COUNTY shall pay to CONTRACTOR, for the performance of this Agreement, subject to any additions or deductions provided herein, the amount not to exceed \_\_\_\_\_. Payment shall be made to the CONTRACTOR once all work has been completed and inspected as satisfactory by COUNTY in accordance with and subject to the provisions set forth in the documents made a part of this

Agreement. CONTRACTOR shall not perform additional services without express written consent from COUNTY.

5. **WORK SAFETY.** CONTRACTOR shall complete site work in a manner that will prevent injury to people and damage to adjacent equipment and facilities. Damage or interference with equipment or facilities shall be immediately corrected.

6. **TIME OF COMPLETION.** The work to be performed under this Agreement shall be diligently prosecuted and substantially completed no later than \_\_\_\_\_.

7. **COMPONENT PARTS OF THIS AGREEMENT.** This Agreement consists of the following component parts, all of which are as fully a part of this Agreement as if herein set out verbatim or, if not attached, as if hereto attached:

- a. This instrument
- b. PLATTE COUNTY Request for Bids for \_\_\_\_\_, to specifically include all specifications for the project.
- c. Responders Bid Forms

In the event that any provision in any of the above component parts of this Agreement conflicts with any provision in any other of the component parts, the provision and the component part first enumerated above shall govern over any other component part which follows it alphabetically, except as may be otherwise specifically stated.

8. **WORK AUTHORIZATION.** The CONTRACTOR shall comply with all Federal, State and local laws, ordinances and regulations applicable to the services. CONTRACTOR shall secure all licenses, manufacturers' certifications, etc. from public and private sources necessary for the fulfillment of its obligations under this Agreement. For purposes of complying with RSMo. Section 285.530, CONTRACTOR shall provide (1) a sworn affidavit, in

the format as attached to this Agreement, that CONTRACTOR participates in E-Verify or other Federal work authorization program as defined in RSMo. Section 285.525(6) with respect to employees that will be working in connection with the contracted services and that CONTRACTOR will not knowingly employ any person who is an unauthorized alien in connection with the contracted services, and (2) documentation to establish that CONTRACTOR participates in E-Verify or other Federal work authorization work program as defined in RSMo. Section 285.525(6).

9. **SAFETY TRAINING.** CONTRACTOR shall provide a ten (10) hour Occupational Safety and Health Administration (OSHA) construction safety program for all employees who will be on-site at the Project. The construction safety program shall include a course in construction safety and health that is approved by OSHA or a similar program approved by the Missouri Department of Labor and Industrial Relations which is at least as stringent as an approved OSHA program as required by Section 292.675 RSMo.

a. CONTRACTOR shall require its on-site employees to complete a construction safety program within sixty (60) days after the date work on the Project commences.

b. CONTRACTOR acknowledges and agrees that any of the CONTRACTOR'S employees found on the Project site without documentation of the successful completion of a construction safety program shall be required to produce such documentation within twenty (20) days, or will be subject to removal from the Project.

c. CONTRACTOR shall require all of its subcontractors to comply with the requirements of this subparagraph b. and Section 292.675 RSMo.

d. Pursuant to Section 292.675 RSMo., CONTRACTOR shall forfeit to the COUNTY as a penalty Two Thousand Five Hundred Dollars (\$2,500.00), plus

One Hundred Dollars (\$100.00) for each on-site employee employed by CONTRACTOR or its Subcontractor, for each calendar day, or portion thereof, such on-site employee is employed without the construction safety training required in subparagraph a.

e. The penalty described in the preceding Section shall not begin to accrue until the time periods described in subparagraphs a. and b. above have lapsed.

f. Violations of this Section and imposition of the penalty described in this Section shall be investigated and determined by the Missouri Department of Labor and Industrial Relations.

10. **TRANSIENT EMPLOYER.** Transient Employer means an employer as defined in Sections 143.191, 287.030 and 288.032 RSMo., making payment of wages taxable under the Missouri Income Tax Law, the Workers' Compensation Law, and the Missouri Employment Security Law, who is not domiciled in the State of Missouri and who temporarily transacts any business with the state. Domicile is defined as the place where the center of the business affairs and functions are discharged.

a. CONTRACTOR, if deemed a transient employer, shall provide a copy of CONTRACTOR'S Notice of Registration with the Missouri Department of Revenue.

b. CONTRACTOR, if deemed a transient employer, shall post at the work site copies of the CONTRACTOR'S Notice of Registration for income tax withholding, proof of coverage of Workers' Compensation Insurance and the Notice of Registration with the Division of Employment Security.

c. CONTRACTOR shall require all of its subcontractors to comply with the requirements of this Section and Sections 285.230 through 285.234 RSMo. as amended."

11. **TERMINATION.** COUNTY may terminate this agreement at any time by giving CONTRACTOR five (5) days written notice of such termination. Immediately upon receipt of notice of termination, the Contractor shall discontinue services and incur no further obligations or expenses. Contractor shall be paid for all work completed prior to effective date of such termination.

12. **ENTIRE AGREEMENT.** This Agreement represents the entire agreement between the parties and supersedes all prior negotiations, representations or agreements, either written or oral. This Agreement may be amended by written instrument, signed by both parties.

This Agreement is entered into as of the date above-written.

**PLATTE COUNTY, MISSOURI**

BY: \_\_\_\_\_  
PRESIDING COMMISSIONER

ATTEST:

\_\_\_\_\_  
COUNTY CLERK

Approved as to form:

\_\_\_\_\_  
COUNTY COUNSELOR

Pursuant to Sections 50.660 and 55.160 RSMo., I certify that there is an unencumbered balance or anticipated revenue to be placed to the credit of the appropriation to which the foregoing expenditure is to be charged, and an unencumbered cash balance or anticipated revenue in the treasury to the credit of the fund from which payment is to be made, each sufficient to meet the obligation hereby incurred.

\_\_\_\_\_  
COUNTY AUDITOR

**CONTRACTOR**

\_\_\_\_\_

\_\_\_\_\_

Printed Name:

\_\_\_\_\_

Attest

**Part 6 – Technical Specifications**  
**Multiuse Field Improvements at Platte Ridge Park**

SECTION 000101 - PROJECT MANUAL TITLE PAGE

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PROJECT: Platte Ridge Park – Football Complex Improvements  
17130 Highway 371  
Platte City, Missouri, 64079

OWNER: Platte County Parks  
415 Third Street  
Platte City, Missouri 64079  
816.858.3337 Phone

ARCHITECT: WSKF Architects  
110 Armour Road  
North Kansas City, Missouri 64116  
816.300.4101 Phone

STRUCTURAL ENGINEER: McClure  
1901 Pennsylvania Drive  
Columbia, Missouri 65202  
573.814.1568 Phone

MECHANICAL AND ELECTRICAL  
ENGINEER: PKMR Engineers  
13300 West 98<sup>th</sup> Street  
Lenexa, Kansas 66215  
785.320.5260 Phone

CIVIL ENGINEER: McClure  
1700 Swift Avenue, Suite 100  
North Kansas City, Missouri 64116  
816.756.0444 Phone

PROJECT NUMBER: 210266-000

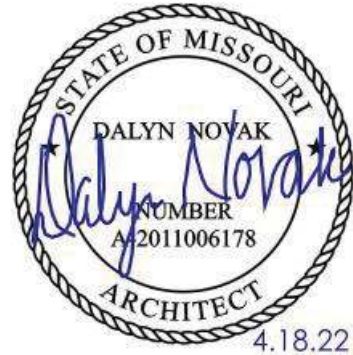
DATE: April 18, 2022

SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Dalyn Novak.
2. License No. 2011006178.
3. Responsible for Divisions 04-32  
Sections except where indicated as  
prepared by other design  
professionals of record



B. Structural Engineer:

1. Kenneth DeYoung.
2. License No. 2006019646.  
Responsible for Divisions 03, 04 22 00,  
05 50 00, 06 10 00, 06 16 00, 06 17 15,  
06 17 53



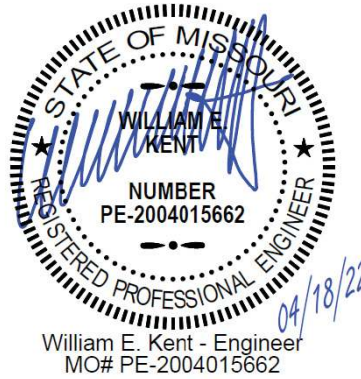
C. Electrical Engineer:

1. Mike Raaf.
2. License No. 2005028097.  
Responsible for Divisions 26, 27



D. Mechanical & Plumbing Engineer:

1. Will Kent.
2. License No. 2004015662.  
Responsible for Divisions 22, 23



END OF DOCUMENT

**PROCUREMENT AND CONTRACTING DOCUMENTS GROUP**

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*Facility Construction Subgroup*

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## SECTION 032000 - CONCRETE REINFORCING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

#### 1.2 ACTION SUBMITTALS

##### A. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

### PART 2 - PRODUCTS

#### 2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

#### 2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
  1. Finish: Plain [ASTM A884/A884M, Class A, Type 1, epoxy coated, with less than 2 percent damaged coating in each 12-inch wire length].

## 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

### 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
- G. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
  - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
  - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  - 4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
  - 1. Place joints perpendicular to main reinforcement.
  - 2. Continue reinforcement across construction joints unless otherwise indicated.
  - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector or qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  - 1. Steel-reinforcement placement.

END OF SECTION 032000

## SECTION 033000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

#### 1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures:
  - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
5. Vapor retarders.
6. Curing materials.
7. Joint fillers.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.

6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Vapor retarders.
5. Joint-filler strips.

B. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures.

#### 1.5 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

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

#### 1.7 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

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

### 2.2 CONCRETE MATERIALS

- A. Cementitious Materials:

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

- B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

- 1. Alkali-Silica Reaction: Comply with one of the following:
    - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
    - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
    - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
  - 2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- C. Air-Entraining Admixture: ASTM C260/C260M.

- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

- 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 2. Retarding Admixture: ASTM C494/C494M, Type B.
  - 3. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

- E. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4

## 2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ISI Building Products.
    - b. Poly-America, L.P.
    - c. Stego Industries, LLC.
    - d. Tex-Trude.

## 2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  - 1. Color:
    - a. Ambient Temperature Below 50 deg F: Black.
    - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
    - c. Ambient Temperature Above 85 deg F: White.
- C. Curing Paper: 8-feet- wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
  - 1. Manufacturers: Subject to compliance with requirements, undefined:
    - a. Fortifiber Building Systems Group.
- D. Water: Potable or complying with ASTM C1602/C1602M.

## 2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

## 2.6 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash or Other Pozzolans: 25 percent by mass.

2. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
3. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

## 2.7 CONCRETE MIXTURES

A. Class A : Normal-weight concrete used for footings, grade beams, and exterior slabs on grade.

1. Exposure Class: ACI 318 F0, F2, C2.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 5 inches, plus or minus 1 inch or 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.
6. Air Content:
  - a. 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

B. Class C : Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 C0, C1.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
5. Slump Limit: 5 inches, plus or minus 1 inch or 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture.
6. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.
7. Air Content:
  - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
8. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

## 2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
  - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
  - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.2 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  - 2. Face laps away from exposed direction of concrete pour.
  - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
  - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
  - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  - 7. Protect vapor retarder during placement of reinforcement and concrete.
    - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

### 3.3 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
  - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  - 2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
  - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

### 3.4 CONCRETE PLACEMENT

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

1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B
  - e. Locations: Apply to concrete surfaces exposed to public view.

### 3.6 FINISHING FLOORS AND SLABS

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

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

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch .

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Engineer before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

### 3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

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

### 3.8 CONCRETE CURING

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

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

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

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

3.9 TOLERANCES

- A. Conform to ACI 117.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  2. Testing agency to immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Testing agency shall report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.

- 6) Date and time of concrete placement.
  - 7) Location in Work of concrete represented by samples.
  - 8) Date and time sample was obtained.
  - 9) Truck and batch ticket numbers.
  - 10) Design compressive strength at 28 days.
  - 11) Concrete mixture designation, proportions, and materials.
  - 12) Field test results.
  - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
  - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections:
1. Verification of use of required design mixture.
  2. Concrete placement, including conveying and depositing.
  3. Curing procedures and maintenance of curing temperature.
  4. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  3. Slump Flow: ASTM C1611/C1611M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; .
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  5. Concrete Temperature: ASTM C1064/C1064M:
    - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
  6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  7. Compression Test Specimens: ASTM C31/C31M:

- a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
- b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C39/C39M.
  - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
  - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
  - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
11. Additional Tests:
  - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
  - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

### 3.11 PROTECTION

#### A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

## SECTION 042200 - CONCRETE UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Steel reinforcing bars.

#### 1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include data on material properties material test reports substantiating compliance with requirements.

#### 1.5 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

### PART 2 - PRODUCTS

#### 2.1 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

## 2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. CMUs: ASTM C90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3250 psi.
  - 2. Density Classification: Normal weight.

## 2.3 CONCRETE LINTELS

- A. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M.
- B. Water: Potable.

## 2.5 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
  - 1. Interior Walls: Hot-dip galvanized, carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.

3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.

## 2.6 MISCELLANEOUS MASONRY ACCESSORIES

## 2.7 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  1. Do not use calcium chloride in mortar or grout.
  2. Use masonry cement mortar unless otherwise indicated.
  3. For exterior masonry, use masonry cement mortar.
  4. For reinforced masonry, use masonry cement mortar.
  5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
  1. For masonry below grade or in contact with earth, use Type M Type S.
  2. For reinforced masonry, use Type S Type N.
  3. For exterior, above-grade, load bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
- E. Grout for Unit Masonry: Comply with ASTM C476.
  1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C476, Table 1 paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
  3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

### 3.2 TOLERANCES

#### A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

#### B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
- 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

#### C. Joints:

- 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
- 2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
- 3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets.

Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- E. Fill cores in hollow CMUs with grout under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.5 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

### 3.6 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches.

### 3.7 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### 3.8 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

## SECTION 042300 - GLASS UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Glass block set in mortar.

B. Related Requirements:

1. Section 042200 "Concrete Masonry Units" for wall construction associated with and surrounding glass unit masonry assemblies.

#### 1.2 SEQUENCING AND SCHEDULING

- A. Sequence and coordinate completion of glass unit masonry assemblies so sealants can be installed immediately after mortar has attained final set.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: Glass-block units and joint materials involving color selection.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store glass block in unopened cartons on elevated platforms, under cover, and in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store glass-block grid materials in unopened cartons in an enclosed, dry location.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Store accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with installation of glass unit masonry assemblies only when ambient and material temperatures are 40 deg F or higher.
  - 1. Maintain temperature in installation areas at 40 deg F or above for 48 hours after installing.
  - 2. Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or when joint substrates are wet.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Glass Block: Obtain glass block from single source from single manufacturer.

### 2.2 GLASS BLOCK

- A. Hollow Glass Block: Hollow units made from transparent glass, with manufacturer's standard edge coating.
  - 1. Glass Color: Colorless.
  - 2. Pattern: Fluted, light-diffusive design, horizontal on one inner face, vertical on other, and smooth outer faces.
  - 3. Edge-Coating Color: White.
  - 4. Sizes: Manufacturer's standard sizes corresponding to nominal sizes indicated on Drawings.
  - 5. Square-Block Size: Match existing Concession/Restroom building size.

### 2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type II. Provide natural color or white cement as required to produce mortar color indicated.
- B. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- C. Water: Potable.

### 2.4 GLASS UNIT MASONRY ACCESSORIES

- A. Panel Reinforcement: Ladder-type units, butt welded, not lapped and welded; complying with ASTM A951/A951M in straight lengths of not less than 10 feet, and as follows:
  - 1. Exterior Walls: Stainless-steel wire.

2. Wire Size: W1.7 or 0.148-inch diameter.
  3. Width: 2 inches.
  4. Spacing of Cross Rods: Not more than 16 inches apart.
- B. Fasteners, General: Unless otherwise indicated, provide Type 304 or Type 316 stainless steel fasteners at exterior walls and zinc-plated fasteners with coating complying with ASTM B633, Class Fe/Zn 5, at interior walls. Select fasteners for type, grade, and class required.
- C. Sealants: Manufacturer's standard elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants."
1. Silicone: Nonstaining, S, NS, 50, NT.
- D. Sealant Accessories: Provide sealant accessories, including primers, bond-breaker tape, and cylindrical sealant backing, that comply with applicable requirements in Section 079200 "Joint Sealants."

## 2.5 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, or antifreeze compounds unless otherwise indicated.
1. Do not use calcium chloride in mortar.
  2. For mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
  3. For pointing mortar in exterior panels, use water-repellent admixture according to admixture manufacturer's written instructions.
  4. Limit cementitious materials in mortar to portland cement and lime.
- B. Mortar for Glass Unit Masonry Assemblies: Comply with ASTM C270, Proportion Specification for Type S mortar.
1. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer unless otherwise indicated. Mix mortar to produce a stiff but workable consistency that is drier than mortar for brick or concrete masonry. Discard mortar when it has reached initial set.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine sills, jambs, and heads surrounding glass unit masonry assemblies, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLING GLASS BLOCK WITH MORTAR

- A. Set glass block with completely filled bed and head joints, with no furrowing, accurately spaced and coordinated with other construction. Maintain 1/4-inch exposed joint widths unless otherwise indicated.
- B. Install panel reinforcement in horizontal joints at spacing indicated and continuously from end to end of panels; comply with the following requirements:
  - 1. Vertical Spacing of Panel Reinforcement for Exterior Panels: Every other course but not more than 16 inches o.c., starting with first course above sill.
  - 2. Do not bridge expansion joints with panel reinforcement.
  - 3. Place panel reinforcement in joints immediately above and below all openings within glass unit masonry assemblies.
  - 4. Lap panel reinforcement not less than 6 inches if more than one length is necessary.
  - 5. Embed panel reinforcement in mortar bed by placing lower half of mortar bed first, pressing panel reinforcement into place, and covering with upper half of mortar bed.
- C. Install panel anchors at locations indicated and in same horizontal joints where panel reinforcement occurs. Extend panel anchors at least 12 inches into joints, and bend within expansion joints at edges of panels and across the head. Attach panel anchors as follows:
  - 1. For new unit masonry assemblies, embed other ends of panel anchors, after bending portions crossing expansion joint, in horizontal mortar joints closest in elevation to joints in glass unit masonry assemblies containing panel anchors.
- D. Use rubber mallet to tap units into position. Do not use steel tools, and do not allow units to come into contact with metal accessories and frames.
- E. Use plastic spacers or temporary wedges in mortar joints to produce uniform joint widths and to prevent mortar from being squeezed out of joints.
  - 1. If temporary wedges are used, remove them after mortar has set and fill voids with mortar.
- F. Keep expansion joints free of mortar.
- G. Rake out joints indicated to be pointed to a uniform depth sufficient to accommodate pointing material, but not less than joint width.
  - 1. If temporary wedges are used, remove them before raking out and pointing joints.
  - 2. Point joints at both faces of exterior panels with mortar.
- H. Point joints with mortar by filling raked joints and voids. Place and compact pointing mortar in layers not more than 3/8 inch thick. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.
  - 1. Tool exposed joints slightly concave when pointing mortar is thumbprint hard. Use a smooth plastic jointer larger than joint width.

- I. Clean glass unit masonry assemblies as work progresses. Remove mortar fins and smears immediately, using a clean, wet sponge or a scrub brush with stiff fiber bristles. Do not use harsh cleaners, acids, abrasives, steel wool, or wire brushes when removing mortar or cleaning glass unit masonry assemblies.
- J. Install sealant at jambs, heads, mullions, and other locations indicated. Prepare joints, including installation of primer and bond-breaker tape or cylindrical sealant backing, and apply elastomeric sealants to comply with requirements in Section 079200 "Joint Sealants."
- K. Construction Tolerances: Set glass block to comply with the following tolerances:
  - 1. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more.
  - 2. Variation from Level: For bed joints and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch in 40 feet or more.
  - 3. Variation in Mortar-Joint Thickness: Do not vary from joint thickness indicated by more than plus or minus 1/16 inch.
  - 4. For faces of adjacent exposed units, do not vary from flush alignment by more than 1/16 inch.

### 3.3 CLEANING

- A. On surfaces adjacent to glass unit masonry assemblies, remove mortar, sealants, and other residue resulting from glass-block installation, in a manner approved by manufacturers of materials involved.
- B. Remove excess sealants with commercial solvents according to sealant manufacturer's written instructions. Exercise care not to damage sealant in joints.
- C. Perform final cleaning of glass unit masonry assemblies when surface is not exposed to direct sunlight. Start at top of panel using generous amounts of clean water. Remove water with clean, dry, soft cloths; change cloths frequently to eliminate dried mortar particles and aggregate.

END OF SECTION 042300

## SECTION 047200 - CAST STONE MASONRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Wall caps.
2. Mortar materials.
3. Accessories.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Verification:

1. For each color and texture of cast stone required, 4 inches square in size.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

1. Include copies of material test reports, indicating compliance of cast stone with ASTM C1364.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.

1. Provide test reports based on testing within previous two years.

#### 1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
  - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
  - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

## 1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Cast Stone: Obtain cast stone units from single source from single manufacturer.

### 2.2 CAST STONE MATERIALS

- A. General: Comply with ASTM C1364.
- B. Portland Cement: ASTM C150/C150M, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C33/C33M; gradation and colors as needed to produce required cast stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C33/C33M, gradation and colors as needed to produce required cast stone textures and colors.

- E. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- F. Admixtures: Use only admixtures specified or approved in writing by Architect.
  - 1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
  - 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
  - 3. Air-Entraining Admixture: ASTM C260/C260M. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
  - 4. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  - 5. Water-Reducing, Retarding Admixture: ASTM C494/C494M, Type D.
  - 6. Water-Reducing, Accelerating Admixture: ASTM C494/C494M, Type E.
- G. Reinforcement:
  - 1. Deformed steel bars complying with ASTM A615/A615M, Grade 40. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
    - a. Epoxy Coating: ASTM A775/A775M.
    - b. Galvanized Coating: ASTM A767/A767M.
- H. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 304.

## 2.3 CAST STONE UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Design Color #1100 as manufactured by Continental Cast Stone or comparable product by one of the following:
  - 1. Architectural Cast Stone, Inc.
  - 2. Architectural Ornaments, Inc.
- B. Cast Stone Units: Comply with ASTM C1364.
  - 1. Units are manufactured using the vibrant dry tamp or wet-cast method.
  - 2. Wall Caps: Sizes as indicated on Drawings.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
  - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
  - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
  - 3. Provide drips on projecting elements unless otherwise indicated.

D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

E. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:
  - a. No fewer than five days at mean daily temperature of 70 deg F or above.
  - b. No fewer than seven days at mean daily temperature of 50 deg F or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

G. Colors and Textures: As selected by Architect from manufacturer's full range.

2.4 MORTAR MATERIALS

- A. Provide mortar materials that comply with Division 04 Section "Unit Masonry."
- B. Water: Potable.

2.5 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- B. Dowels: 1/2-inch-diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Diedrich Technologies, Inc.

- b. EaCo Chem, Inc.
- c. ProSoCo, Inc.

## 2.6 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.
- B. Comply with ASTM C270, Proportion Specification.
  - 1. For setting mortar, use Type S.
  - 2. For pointing mortar, use Type N.

## 2.7 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C1364.
  - 1. Include one test for resistance to freezing and thawing.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

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

## 3.2 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated in TMS 604.
- B. Install cast stone units to comply with requirements in Division 04 Section "Unit Masonry."
- C. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
  - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
  - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- D. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- E. Set units in full bed of mortar with full head joints unless otherwise indicated.
  - 1. Set units with joints 1/4 to 3/8 inch wide unless otherwise indicated.

2. Build anchors and ties into mortar joints as units are set.
  3. Fill dowel holes and anchor slots with mortar.
  4. Build concealed flashing into mortar joints as units are set.
- F. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- G. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- H. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
- I. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
1. Keep joints free of mortar and other rigid materials.
  2. Build in compressible foam-plastic joint fillers where indicated.
  3. Form joint of width indicated, but not less than 3/8 inch.
  4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
  5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

### 3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
  2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- B. Fill anchor holes with sealant.
1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- C. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- D. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
1. Form open joint of width indicated, but not less than 3/8 inch.

- E. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- F. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

### 3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 ft., or 1/2 inch maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 ft., or 1/2 inch maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warp of units within tolerances specified.

### 3.5 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
  - 1. Remove mortar fins and smears before tooling joints.
  - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
  - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
  - 5. Clean cast stone by methods described in Cast Stone Institute Technical Bulletin #39.
  - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal Fabrications.

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

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete.

#### 1.2 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details.

### PART 2 - PRODUCTS

#### 2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Stainless Steel Bars and Shapes: ASTM A276/A276M,.

#### 2.2 MISCELLANEOUS MATERIALS

- A. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

#### 2.3 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

## 2.4 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Galvanize and prime loose steel lintels located in exterior walls.
- C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.

## 2.6 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3.
  - 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
  - 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

#### 3.2 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

## SECTION 061000 - ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Wood blocking and nailers.
4. Wood furring.

### PART 2 - PRODUCTS

#### 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber 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, .
3. Dress lumber, S4S, unless otherwise indicated.

##### B. Maximum Moisture Content:

1. Boards: 19 percent.
2. Dimension Lumber: 19 percent unless otherwise indicated.
3. Timber: 19 percent .

- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

#### 2.2 PRESERVATIVE TREATMENT

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat
  1. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

## 2.3 DIMENSION LUMBER FRAMING

- A. Framing Other Than Non-Load-Bearing Partitions by Grade: No. 2 grade.
  1. Application: Framing other than interior partitions.
  2. Species:
    - a. Hem-fir (north); NLGA.
    - b. Southern pine; SPIB.
    - c. Douglas fir-larch; WCLIB or WWPA.
    - d. Southern pine or mixed southern pine; SPIB.
    - e. Spruce-pine-fir; NLGA.
    - f. Douglas fir-south; WWPA.
    - g. Hem-fir; WCLIB or WWPA.
    - h. Douglas fir-larch (north); NLGA.

## 2.4 ENGINEERED WOOD PRODUCTS

- A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boise Cascade.
    - b. Pacific Woodtech Corporation.
    - c. Roseburg.
    - d. West Fraser.
    - e. Weyerhaeuser Company.
  2. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 12-inch nominal- depth members.
  3. Modulus of Elasticity, Edgewise: 2,000,000 psi .

## 2.5 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
- B. Dimension Lumber Items: Construction or No. 2 Standard, Stud, or No. 3 grade lumber of any species.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
  - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
  - 2. Eastern softwoods; No. 2 Common grade; NeLMA.
  - 3. Northern species; No. 2 Common grade; NLGA.
  - 4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

## 2.6 FASTENERS

- A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M .

## 2.7 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. MiTek Industries, Inc.
  - 2. Simpson Strong-Tie Co., Inc.
- B. Allowable design loads, as published by manufacturer, are to meet or exceed those indicated . Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
  - 1. Use for interior locations unless otherwise indicated.

- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; 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-preserved-treated lumber and where indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  - 3. ICC-ES evaluation report for fastener.

### 3.2 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 rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

## SECTION 061600 - SHEATHING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Roof sheathing.

### PART 2 - PRODUCTS

#### 2.1 ROOF SHEATHING

- A. Plywood Sheathing, Roofs: , Exposure 1, Structural I sheathing.
- B. Oriented-Strand-Board Sheathing, Roofs: DOC PS 2, Exposure 1, Structural I sheathing.

#### 2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M .

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
  2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
  3. ICC-ES evaluation report for fastener.

- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Wall and Roof Sheathing:
    - a. Nail to wood framing.
    - b. Screw to cold-formed metal framing.
    - c. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 061600

## SECTION 061715 - ENGINEERED STRUCTURAL WOOD

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Structural composite lumber.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

#### 1.3 QUALITY ASSURANCE

- ##### A. Fabricator Qualifications:
- Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in ASTM D5055 or ASTM D5456, and involves third-party inspection by an independent testing and inspecting agency acceptable to Engineer and authorities having jurisdiction .

### PART 2 - PRODUCTS

#### 2.1 STRUCTURAL COMPOSITE LUMBER

- ##### A. General:
- Provide structural composite lumber that complies with ASTM D5456 and ASTM D2559 or research/evaluation reports acceptable to authorities having jurisdiction.
- ##### B. Laminated-Veneer Lumber (LVL):
- Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Boise Cascade.
    - b. Pacific Woodtech Corporation.
    - c. Roseburg.
    - d. West Fraser.
    - e. Weyerhaeuser Company.
  2. Allowable Stresses:
    - a. Extreme Fiber Stress in Bending, Edgewise (Fb): 2900 psi for 12-inch nominal-depth members.
    - b. Modulus of Elasticity, Edgewise (E): 2,000,000 psi .

## 2.2 FASTENERS

- A. General: Fasteners are to be of size and type indicated and to comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329 .
  - 2. For pressure-preservative-treated wood, use stainless steel fasteners.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- E. Carbon Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.
- G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF STRUCTURAL COMPOSITE LUMBER

- A. Install to comply with ESR report, manufacturer's written instructions, and applicable code.
  - 1. Install in dry, covered conditions where average in-service moisture content of lumber is 16 percent or less.
  - 2. Install metal framing connections in accordance with AWC's "National Design Specification (NDS) for Wood Construction." Install fasteners through each fastener hole.
  - 3. Install lumber plumb and level. Accurately fit, align, securely fasten, and install free from distortion or defects.
  - 4. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
- B. Cutting: Confirm size and location of field cutting, notching, and drilling with ESR report, registered design professional, and manufacturer.

END OF SECTION 061715

## SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Wood roof trusses.

#### 1.2 ACTION SUBMITTALS

A. 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.

B. Delegated-Design Submittals: 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.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

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

1. Metal-plate connectors.
2. Metal truss accessories.

#### 1.4 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 Engineer and authorities having jurisdiction.

## 1.5 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."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, to design metal-plate-connected wood trusses.
- B. Structural Performance: Metal-plate-connected wood trusses are to be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1.
- 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."

### 2.2 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. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

### 2.3 METAL CONNECTOR PLATES

- A. Manufacturers:
  1. Alpine, a division of ITW Inc.

2. Eagle Metal Products.
3. MiTek Industries, Inc.

B. Fabricate connector plates to comply with TPI 1.

C. Hot-Dip Galvanized-Steel Sheet: ASTM A653/A653M; 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.

## 2.4 FASTENERS

A. 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, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

## 2.5 METAL FRAMING ANCHORS AND ACCESSORIES

A. Manufacturers:

1. Simpson Strong-Tie Co., Inc.
2. Phoenix Metal Products, Inc.

B. Allowable design loads, as published by manufacturer, are to comply with or exceed those. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

## 2.6 FABRICATION

A. 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.

- B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

### PART 3 - EXECUTION

#### 3.1 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. 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.
- F. 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 061000 "Rough Carpentry."
- G. Install wood trusses within installation tolerances in TPI 1.
- H. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- I. Replace wood trusses that are damaged or do not comply with requirements.

END OF SECTION 061753

## SECTION 066400 - PLASTIC PANELING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Factory-laminated plastic sheet paneling.
- B. Related Requirements:
  - 1. Section 061000 "Rough Carpentry" for wood furring for installing plastic paneling.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling, in manufacturer's standard sizes.

#### 1.3 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

### PART 2 - PRODUCTS

#### 2.1 SOURCE LIMITATIONS

- A. Obtain plastic paneling and trim accessories from single manufacturer.

#### 2.2 FACTORY-LAMINATED PLASTIC SHEET PANELING

- A. Factory-Laminated Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319, laminated to plywood. Panels are to be USDA accepted for incidental food contact.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Composites, Inc.
    - b. Glasteel.
    - c. Nudo.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 25 or less.
  - b. Smoke-Developed Index: 450 or less.
3. Glass-Fiber-Reinforced Plastic Panel Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: Molded pebble texture.
5. Color: As selected by Architect from manufacturer's full range.
6. Plywood: DOC PS 1, Exterior B-C, 5/8 inch thick.

## 2.3 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, and caps as needed to conceal edges.
  1. Color: As selected by Architect from manufacturer's full range.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints where indicated.

1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
  1. Drill oversized fastener holes in panels and center fasteners in holes.
  2. Apply sealant to fastener holes before installing fasteners.
- C. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Glass-fiber blanket insulation.
- B. Related Requirements:
  - 1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Research Reports: For foam-plastic insulation, from ICC-ES.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

### PART 2 - PRODUCTS

#### 2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

- B. Extruded Polystyrene Board, Type IV (Foundation Insulation): ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

- 1. Basis of Design: Dow Styrofoam, Perimate or approved equal.

## 2.2 GLASS-FIBER BLANKET INSULATION

- A. Glass-Fiber Blanket, Kraft Faced: ASTM C 665, Type II (non-reflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

## 2.3 ACCESSORIES

- A. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

## 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

## 3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For wood-framed construction, install blankets according to ASTM C1320 and as follows:
  - a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

#### 3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

## SECTION 073113 - ASPHALT SHINGLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Metal flashing and trim.

#### 1.2 DEFINITIONS

- A. Roofing Terminology: See ASTM D1079 for definitions of terms related to roofing Work in this Section.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and blend specified, in sizes indicated.
1. Asphalt Shingles: Full size.
  2. Ridge and Hip Cap Shingles: Full size.
  3. Ridge Vent: 12-inch-long Sample.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by a qualified testing agency.
- B. Sample Warranty: For manufacturer's materials warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For asphalt shingles to include in maintenance manuals.
- B. Materials warranties.
- C. Roofing Installer's warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Asphalt Shingles: 100 sq. ft. of each type and in each color and blend, in unbroken bundles.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized installer who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions.
- B. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double-stack rolls.
- C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing Work is not in progress.
- D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.
  - 1. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.10 WARRANTY

- A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Manufacturing defects.
  - 2. Materials Warranty Period: 30 years from date of Substantial Completion, prorated, with first 10 years nonprorated.
  - 3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 130 mph for five years from date of Substantial Completion.

4. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 10 years from date of Substantial Completion.
  5. Workmanship Warranty Period: Two years from date of Substantial Completion.
- B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of product from single source from single manufacturer.

### 2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D3462/D3462M, laminated, multi-ply overlay construction; glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
1. Basis of Design: GAF Timberline HD shingle or approved equal.
  2. Butt Edge: Manufacturer's standard cut.
  3. Strip Size: Manufacturer's standard size.
  4. Algae Resistance: Granules resist algae discoloration.
  5. Color and Blends: Match existing Concessions Building.

### 2.3 UNDERLAYMENT MATERIALS

- A. Organic Felt: Asphalt-saturated organic felts, nonperforated and complying with the following:
1. ASTM D4869/D4869M: Type II.

### 2.4 RIDGE VENTS

- A. Rigid Ridge Vent: Manufacturer's standard, rigid-section, high-density, UV-stabilized plastic ridge vent for use under ridge shingles.
1. Minimum Net Free Area: 18 square inches per foot.
  2. Width: 12 inches.
  3. Thickness: Manufacturer's standard thickness.
  4. Features:
    - a. Nonwoven geotextile filter strips.
    - b. External deflector baffles.

## 2.5 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.
- B. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch-diameter, sharp-pointed, with a 3/8- to 7/16-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through sheathing less than 3/4 inch thick.
  - 1. Shank: Barbed.
  - 2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, 1-inch-minimum diameter.
  - 1. Provide with minimum 0.0134-inch-thick metal cap, 0.010-inch-thick power-driven metal cap, or 0.035-inch-thick plastic cap; and with minimum 0.083-inch-thick ring shank or 0.091-inch-thick smooth shank of length to penetrate at least 3/4 inch into roof sheathing or to penetrate through roof sheathing less than 3/4 inch thick.

## 2.6 METAL FLASHING AND TRIM

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
  - 1. Sheet Metal: Anodized aluminum.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise specified in this Section or indicated on Drawings.
  - 1. Apron Flashings: Fabricate with lower flange a minimum of 4 inches over and 4 inches beyond each side of downslope asphalt shingles and 6 inches up the vertical surface.
  - 2. Drip Edges: Fabricate in lengths not exceeding 10 feet with minimum 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge.
  - 3. Vent-Pipe Flashings: ASTM B749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through asphalt shingles.
  3. Verify that penetrations through roofing are installed and securely fastened.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF UNDERLAYMENT MATERIALS

- A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.
- B. Asphalt-Saturated Felt: Install on roof deck parallel with and starting at eaves and fasten with underlayment nails.
1. Single-Layer Installation:
    - a. Lap sides a minimum of 4 inches over underlying course.
    - b. Lap ends a minimum of 4 inches.
    - c. Stagger end laps between succeeding courses at least 72 inches.

### 3.3 INSTALLATION OF METAL FLASHING AND TRIM

- A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
1. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.
- B. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of 4 inches secured in a waterproof manner.
1. Install in reglets or receivers.
- C. Step Flashings: Install with a headlap of 2 inches and extend over the underlying asphalt shingle and up the vertical surface. Fasten to roof deck only.
- D. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.
- E. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.
- F. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

### 3.4 INSTALLATION OF ASPHALT SHINGLES

- A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in ARMA's "Asphalt Roofing Residential Manual - Design and Application Methods" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed at least 7 inches wide with self-sealing strip face up at roof edge.
  - 1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
  - 2. Install starter strip along rake edge.
- C. Install first and remaining courses of three-tab-strip asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt shingle strips with a minimum of five roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.
  - 1. Locate fasteners in accordance with manufacturer's written instructions.
  - 2. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
- E. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.
- F. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.
  - 1. Fasten with roofing nails of sufficient length to penetrate sheathing.
  - 2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

### 3.5 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("the work") on the following project:
  - 1. Owner: <Insert name of Owner>.
  - 2. Owner Address: <Insert address>.
  - 3. Building Name/Type: <Insert information>.
  - 4. Building Address: <Insert address>.
  - 5. Area of the Work: <Insert information>.
  - 6. Acceptance Date: <Insert date>.
  - 7. Warranty Period: <Insert time>.
  - 8. Expiration Date: <Insert date>.

- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant the work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that, during Warranty Period, Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of the work as are necessary to correct faulty and defective work and as are necessary to maintain the work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  - 1. Specifically excluded from this Warranty are damages to the work and other parts of the building, and to building contents, caused by:
    - a. Lightning;
    - b. Peak gust wind speed exceeding 130 mph;
    - c. Fire;
    - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. Faulty construction of copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. Vapor condensation on bottom of roofing; and
    - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  - 2. When the work has been damaged by any of foregoing causes, Warranty is to be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  - 3. Roofing Installer is responsible for damage to the work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the work.
  - 4. During Warranty Period, if Owner allows alteration of the work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty becomes null and void on date of the alterations, but only to the extent the alterations affect the work covered by this Warranty. If Owner engages Roofing Installer to perform the alterations, Warranty does not become null and void unless Roofing Installer, before starting the alterations, notified Owner in writing, showing reasonable cause for claim, that the alterations would likely damage or deteriorate the work, thereby reasonably justifying a limitation or termination of this Warranty.
  - 5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty becomes null and void on date of the change, but only to the extent the change affects the work covered by this Warranty.
  - 6. Owner promptly notifies Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and affords reasonable opportunity for Roofing Installer to inspect the work and to examine evidence of such leaks, defects, or deterioration.
  - 7. This Warranty is recognized to be the only warranty of Roofing Installer on the work and does not operate to restrict or cut off Owner from other remedies and resources lawfully

available to Owner in cases of roofing failure. Specifically, this Warranty does not operate to relieve Roofing Installer of responsibility for performance of the work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

END OF SECTION 073113

## SECTION 074646 - FIBER-CEMENT SIDING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes fiber-cement siding trim, and soffit.
- B. Related Requirements:
  - 1. Section 061000 "Rough Carpentry" for wood furring, grounds, nailers, and blocking.

#### 1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For fiber-cement siding, trim, and soffit including related accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fiber-cement siding, trim, and soffit.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- D. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracking and deforming.
    - b. Deterioration of materials beyond normal weathering.
  - 2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
  - 1. Basis of Design: LP Smartside, Panel, Trim, Fascia, & Vented Soffit as manufactured by LP Buildin Products.
- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness (Panel): Not less than 3/8 inch.
- D. Nominal Thickness (Trim): Not less than 3/4 inches.
- E. Panel: Width, 4 foot x 8 foot.
  - 1. Texture: Wood grain.
- F. Trim Boards: Width, refer to drawings.
  - 1. Texture: Wood grain.

- G. Factory Priming: Manufacturer's standard acrylic primer.

## 2.3 FIBER-CEMENT SOFFIT

- A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
- B. Nominal Thickness: Not less than 3/8 inch.
- C. Pattern: Manufacturer's standard length sheets with wood-grain texture.
- D. Ventilation: Provide perforated soffit.
- E. Factory Priming: Manufacturer's standard acrylic primer.

## 2.4 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
  - 1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
- B. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
  - 1. Finish for Aluminum Flashing: High-performance organic finish.
- C. Fasteners:
  - 1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
  - 2. For fastening fiber cement, use hot-dip galvanized fasteners.
- D. Insect Screening for Soffit Vents: Manufacturer's standard mesh.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and soffit and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
  - 1. Do not install damaged components.
  - 2. Install fasteners no more than 24 inches o.c.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof-drainage sheet metal fabrications.
2. Miscellaneous sheet metal fabrications.
3. Formed siding and trim sheet metal fabrications.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.

#### 1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
  - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
  - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

## 1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

### 2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color: As selected by Architect from manufacturer's full range to match existing Concessions Building.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

## 2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners:
  1. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

## 2.4 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
  1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  2. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  3. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
  1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.

- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Do not use graphite pencils to mark metal surfaces.

## 2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

### A. Hanging Gutters:

- 1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
- 2. Fabricate in minimum 96-inch-long sections.
- 3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
- 4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
- 5. Gutter Profile: Style K in accordance with cited sheet metal standard.
- 6. Expansion Joints: Lap type.

### B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.

- 1. Fabricated Hanger Style: Fig. 1-35C in accordance with SMACNA's "Architectural Sheet Metal Manual."
- 2. Fabricate from the following materials:
  - a. Aluminum: 0.024 inch thick.

## 2.6 WALL SHEET METAL FABRICATIONS

### A. Drip Edges: Fabricate from the following materials:

- 1. Aluminum: 0.032 inch thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
  - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder.
  - 2. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 3. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  - 4. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  - 5. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  - 6. Do not use graphite pencils to mark metal surfaces.
- B. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- C. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

### 3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
  - 1. Join sections with riveted and soldered joints.
  - 2. Provide for thermal expansion.
  - 3. Attach gutters at eave or fascia to firmly anchor them in position.
  - 4. Provide end closures and seal watertight with sealant.
  - 5. Slope to downspouts.
  - 6. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
  - 7. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
  - 8. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 30 feet apart. Install expansion-joint caps.
- C. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Connect downspouts to underground drainage system.

### 3.4 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
  1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
  1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.

### 3.5 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.6 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.

### 3.7 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

#### 1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.6 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer.

### 2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.3 SILICONE JOINT SEALANTS

- A. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant: ASTM C 920, Type S, Grade NS, Class 25, Use NT.

## 2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 35, T, NT, M, A, G & I: Single-component, nonsag, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 35, Uses T, NT, M, A, G and I.
  - 1. Basis of Design: MasterSeal NP 1 (formerly Sonolastic NP 1) as manufactured by BASF Corporation.

## 2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

## 2.6 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

### 3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without

deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.
- b. Tile control and expansion joints.
- c. Vertical joints on exposed surfaces of unit masonry walls and partitions.
- d. Joints at perimeter of door, window and louver openings.
- e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 35, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
- b. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

#### 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

#### 1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Locations of reinforcement and preparations for hardware.
4. Details of each different wall opening condition.
5. Details of accessories.

- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ceco Door; AADG, Inc.; ASSA ABLOY.
2. Curries, AADG, Inc.; ASSA ABLOY Group.
3. Steelcraft; Allegion plc.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.
1. Doors:
- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches.
- c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch.
- d. Edge Construction: Model 1, Full Flush.
- e. Edge Bevel: Provide manufacturer's standard beveled or square edges.

- f. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
- 2. Frames:
  - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
  - b. Construction: Full profile welded.
- 3. Exposed Finish: Prime.

## 2.3 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
    - d. Edge Construction: Model 1, Full Flush.
    - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
    - g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
    - h. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
  - 2. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
    - b. Construction: Full profile welded.
  - 3. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

## 2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

## 2.6 FABRICATION

- A. Hollow-Metal Doors:
  1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
  2. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
  3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
  4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
  5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
  - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
  1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 or NAAMM-HMMA 840.
  1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Install frames with removable stops located on secure side of opening.

2. Floor Anchors: Secure with post-installed expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.
  3. Solidly pack mineral-fiber insulation inside frames.
  4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  5. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.

### 3.3 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.
- D. Remove grout and other bonding material from hollow-metal work immediately after installation.

END OF SECTION 081113

## SECTION 083313 - COILING COUNTER DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Counter door assemblies.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.
  - 1. Obtain operators and controls from coiling counter door manufacturer.

### 2.2 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Basis of Design: Overhead Door Corporation, Model 655.
    - b. Clopay Building Products.
    - c. Cookson; a CornellCookson company.
    - d. Cornell; a CornellCookson company.
    - e. Overhead Door Corporation.
    - f. Raynor Garage Doors.
    - g. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. Door Curtain Material: Aluminum.
- D. Door Curtain Slats: Flat profile slats of 1-1/4-inch center-to-center height.
  - 1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated aluminum extrusion and finished to match door.
- F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- G. Hood: Stainless steel.
  - 1. Shape: Square.
  - 2. Mounting: Face of wall.
- H. Integral Frame, Hood, and Fascia: Stainless steel.
  - 1. Mounting: Face of wall.

- I. Sill Configuration: Integral metal sill.
- J. Locking Devices: Equip door with locking device assembly.
  - 1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumbturn and outside with cylinder.
- K. Manual Door Operator: Push-up operation.
- L. Curtain Accessories: Equip door with weatherseals push/pull handles.
- M. Door Finish:
  - 1. Aluminum Finish: Clear anodized.

## 2.3 DOOR CURTAIN MATERIALS AND FABRICATION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

## 2.4 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Stainless Steel: 0.025-inch-thick, stainless steel sheet, Type 304, complying with ASTM A240/A240M or ASTM A666.
- B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):
  - 1. Stainless Steel: Type 304, complying with ASTM A240/A240M or ASTM A666.

## 2.5 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
  - 1. Lock Cylinders: As standard with manufacturer and keyed to building keying system.
  - 2. Keys: Three for each cylinder.

## 2.6 CURTAIN ACCESSORIES

- A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.
  - 1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
  - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.
- B. Astragal: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
- C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

## 2.7 COUNTER DOOR ACCESSORIES

- A. Integral Metal Sill: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with ASTM A480/A480M No. 4 finish.

## 2.8 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf.

## 2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.11 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## 2.12 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: ASTM A480/A480M No. 4.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

### 3.3 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.
  - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

### 3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

END OF SECTION 083313

## SECTION 083613 - SECTIONAL DOORS

### 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. Sectional-door assemblies.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
  - 2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied finishes.
  - 1. Include Samples of accessories involving color selection.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For manufacturer's warranty and finish warranty.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.
- B. Manufacturer's warranty.
- C. Finish warranty.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Failure of components or operators before reaching required number of operation cycles.
    - c. Faulty operation of hardware.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
    - e. Delamination of exterior or interior facing materials.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
  - 1. Obtain operators and controls from sectional door manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  - 1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.

2. Testing: In accordance with ASTM E330/E330M.
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
  - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
  - b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
4. Operability under Wind Load: Design sectional doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. wind load, acting inward and outward.

## 2.3 SECTIONAL-DOOR ASSEMBLY

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Overhead Door Corporation.
    - b. Raynor Garage Doors.
    - c. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 10,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. when tested in accordance with ASTM E283 or DASMA 105.
- D. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G60 zinc coating.
  1. Door-Section Thickness: 1-3/4 inches.
  2. Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of dimension recommended in writing by manufacturer to comply with performance requirements.
    - a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
    - b. Hardware Locations: Provide reinforcement for hardware attachment.
- E. Track: Manufacturer's standard, galvanized-steel, standard-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
  1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
  2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.

3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
- F. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top and around entire perimeter of door.
- G. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
  1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
    - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
    - b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.
  2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
    - a. Roller-Tire Material: Manufacturer's standard.
- H. Locking Devices: Equip door with locking device assembly.
  1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb-turn and outside with cylinder.
- I. Counterbalance Mechanism:
  1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
- J. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  1. Comply with NFPA 70.
  2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
  3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
  4. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
  5. Operator Type: Trolley.

6. Motor: Reversible-type with controller (disconnect switch) for exterior, dusty, wet, or humid motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
    - a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
    - b. Electrical Characteristics:
      - 1) Phase: Single phase.
      - 2) Volts: 115 V.
  7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
  8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
    - a. Monitored Entrapment Protection: Photoelectric sensor designed to interface with door-operator control circuit to detect damage to or disconnection of sensor and complying with requirements in UL 325.
  9. Control Station: Surface mounted, three-position (open, close, and stop) control.
    - a. Operation: Push button.
    - b. Interior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof-type, NEMA ICS 6, Type 4 enclosure.
  10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
  11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
  12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
  - 1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
  - 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

#### 3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 083613

## SECTION 085113 - ALUMINUM WINDOWS

### 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 aluminum windows for exterior locations.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
  - 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
  - 1. Exposed Finishes: 2 by 4 inches.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Sample Warranties: For manufacturer's warranties.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
    - c. Faulty operation of movable sash and hardware.
    - d. Deterioration of materials and finishes beyond normal weathering.
    - e. Failure of insulating glass.
  2. Warranty Period:
    - a. Window: 10 years from date of Substantial Completion.
    - b. Glazing Units: 10 years from date of Substantial Completion.
    - c. Aluminum Finish: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

### 2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
1. Minimum Performance Class: CW.
  2. Minimum Performance Grade: 30.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface

temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

## 2.3 ALUMINUM WINDOWS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. EFCO Corporation.
  2. Kawneer Company, Inc.; Arconic Corporation.
  3. Manko Window Systems, Inc.
- B. Types: Provide the following types in locations indicated on Drawings:
  1. Horizontal sliding.
  2. Fixed.
- C. Frames and Sashes: Aluminum extrusions complying with AMA/WDMA/CSA 101/I.S.2/A440.
  1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- D. Insulating-Glass Units: ASTM E2190.
  1. Glass: ASTM C1036, Type 1, Class 1, q3.
    - a. Tint: Clear.
    - b. Kind: Fully tempered.
  2. Lites: Two.
  3. Filling: Fill space between glass lites with air.
- E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
  1. Dual Glazing System:
    - a. Interior Lite: ASTM C 1172 clear laminated glass with two plies of float glass.
      - 1) Float Glass: Annealed.
      - 2) Interlayer Thickness: 0.090 inch.
    - b. Exterior Lite: Exterior Lite: ASTM C 1036, Type 1, Class 1, q3.
      - 1) Tint: Bronze.
      - 2) Kind: Heat strengthened.

- F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
  - 1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- G. Horizontal-Sliding Window Hardware:
  - 1. Sill Cap/Track: Extruded-aluminum track with natural anodized finish of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
  - 2. Roller Assemblies: Low-friction design.
- H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
  - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

## 2.4 ACCESSORIES

- A. Subsills: Nonthermal, extruded-aluminum subsills in configurations indicated on Drawings.
- B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

## 2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
  - 1. Color: Dark bronze.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### 3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
  - 1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

## SECTION 087100 – DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Cylinders specified for doors in other sections.
- C. Related Sections:
  - 1. Division 08 Section “Door Hardware Schedule”.
  - 2. Division 08 Section “Hollow Metal Doors and Frames”.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series
  - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

#### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- D. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying mechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning standard door hardware and keying.
- C. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
- D. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- E. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
- F. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### 1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

## 1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- C. Special Warranty Periods:
  - 1. Ten years for mortise locks and latches.
  - 2. Twenty five years for manual surface door closer bodies.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

### 2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
    - a. Three Hinges: For doors with heights 61 to 90 inches.

2. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  3. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
    - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
  4. Acceptable Manufacturers:
    - a. Bommer Industries (BO).
    - b. Hager Companies (HA).
    - c. McKinney Products (MK).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations.
1. Acceptable Manufacturers:
    - a. Bommer Industries (BO).
    - b. McKinney Products (MK).
    - c. Pemko Manufacturing (PE).

## 2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
1. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU).
    - b. Sargent Manufacturing (SA).
    - c. Yale Locks and Hardware (YA).
- B. Cylinders: Original manufacturer cylinders complying with the following:
1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
  2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
  4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

- C. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.
  - 1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.
    - a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.
  - 2. Acceptable Manufacturer:
    - a. Sargent Manufacturing (SA) - Degree Series.
    - b. Corbin Russwin (RU) – Access 3 Series.
- D. Keying System: Each type of lock and cylinders to be factory keyed.
  - 1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
  - 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  - 3. New System: Key locks to a new key system as directed by the Owner.
- E. Key Quantity: Provide the following minimum number of keys:
  - 1. Change Keys per Cylinder: Two (2)
  - 2. Master Keys (per Master Key Level/Group): Five (5).
  - 3. Construction Keys (where required): Ten (10).
- F. Construction Keying: Provide construction master keyed cylinders.
- G. Key Registration List (Bitting List):
  - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
  - 2. Provide transcript list in writing or electronic file as directed by the Owner.

## 2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
  - 1. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU) – ML2000 Series.
    - b. Sargent Manufacturing (SA) – 8200 Series.

c. Yale Locks and Hardware (YA) – 8800FL Series.

B. Lock Trim Design: As specified in Hardware Sets.

## 2.5 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

## 2.6 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
  - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.

- c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
    - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
  - 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
  - 1. Acceptable Manufacturers:
    - a. Corbin Russwin Hardware (RU) - DC8000 Series.
    - b. Sargent Manufacturing (SA) - 351 Series.
    - c. Norton Door Controls (NO) - 7500 Series.
    - d. Yale Locks and Hardware (YA) - 4400 Series.

## 2.7 ARCHITECTURAL TRIM

### A. Door Protective Trim

- 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
- 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
- 3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:
  - a. Stainless Steel: 300 series, .050-inch thick, with countersunk screw holes (CSK).
- 4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
- 5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.

6. Acceptable Manufacturers:

- a. Burns Manufacturing (BU).
- b. Rockwood Manufacturing (RO).
- c. Trimco (TC).

2.8 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:

- a. Burns Manufacturing (BU).
- b. Rockwood Manufacturing (RO).
- c. Trimco (TC).

2.9 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- C. Acceptable Manufacturers:
  - 1. National Guard Products (NG).
  - 2. Pemko Manufacturing (PE).
  - 3. Reese Enterprises, Inc. (RS).

2.10 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## 2.11 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

### 3.3 INSTALLATION

- A. Install each item of mechanical hardware to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

- D. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.5 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

### 3.6 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

#### **Hardware Schedule**

Abbreviation	Name
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
MCK	Mckinney Products Co
PEM	Pemko Mfg Co
ROC	Rockwood Manufacturing Co.
SAR	Sargent Manufacturing Co

71150 OPT0258141 Version 1

Legend:

 Link to catalog cut sheet

 Electrified Opening

Hardware Group No. 010.0

For use on Door #(s):

100A 102B

Provide each RU door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
	EA	OH Door - All Hardware by Door Mfg			

Hardware Group No. 020.0

For use on Door #(s):

100B

Provide each SGL door(s) with the following:


QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	T4A3386 4 1/2" X 4 1/2"	US32D	MCK
1	EA	MORTISE LOCK - STOREROOM	DG1 8204 LNL	US26D	SAR
1	EA	CLOSER	351-O	EN	SAR
1	EA	KICK PLATE	K1050 10" X 2" LDW 4BE CSK 	630	ROC
1	EA	KICK DOWN HOLDER	FS555 	689	IVE
1	SET	GASKETING	2891APK 	AL	PEM
1	EA	GASKETING	290APK	AL	PEM
1	EA	RAIN DRIP	346A	AL	PEM
1	EA	DOOR SWEEP	3452AV 	AL	PEM
1	EA	THRESHOLD	253X3AFG 	AL	PEM

Hardware Group No. 030.0

For use on Door #(s):

101







Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	TA2714 4 1/2" X 4 1/2"	US26D	MCK
1	EA	MORTISE LOCK - STOREROOM	DG1 8204 LNL	US26D	SAR
1	EA	KICK DOWN HOLDER	FS555 	689	IVE

Hardware Group No. 040.0

For use on Door #(s):  
102A





Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	T4A3386 4 1/2" X 4 1/2"		US32D	MCK
1	EA	MORTISE LOCK - STOREROOM	DG1 8204 LNL		US26D	SAR
1	EA	OH STOP	90S		630	GLY
1	EA	CLOSER	351-O		EN	SAR
1	EA	KICK PLATE	K1050 10" X 2" LDW 4BE CSK		630	ROC
1	EA	KICK DOWN HOLDER	FS555		689	IVE
1	SET	GASKETING	2891APK		AL	PEM
1	EA	RAIN DRIP	346A		AL	PEM
1	EA	DOOR SWEEP	3452AV		AL	PEM
1	EA	THRESHOLD	253X3AFG		AL	PEM

Hardware Group No. 050.0

For use on Door #(s):  
103 105






Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	T4A3386 4 1/2" X 4 1/2"		US32D	MCK
1	EA	DEADBOLT - CLASSROOM	DG1 487		US26D	SAR
1	EA	DOOR PULL	110 X 70C		630	ROC
1	EA	PUSH PLATE	70C		630	ROC
1	EA	CLOSER	351-O		EN	SAR
1	EA	WALL STOP	409		630	ROC
1	SET	GASKETING	2891APK		AL	PEM
1	EA	DOOR SWEEP	3452AV		AL	PEM
1	EA	THRESHOLD	253X3AFG		AL	PEM

Hardware Group No. 060.0

For use on Door #(s):  
104

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	T4A3386 4 1/2" X 4 1/2"		US32D	MCK
1	EA	MORTISE LOCK - STOREROOM	8204 LNL		US26D	SAR
1	EA	CLOSER	351-O		EN	SAR
1	EA	KICK PLATE	K1050 10" X 2" LDW 4BE CSK		630	ROC
1	EA	KICK DOWN HOLDER	FS555		689	IVE
1	SET	GASKETING	2891APK		AL	PEM
1	EA	DOOR SWEEP	3452AV		AL	PEM
1	EA	THRESHOLD	253X3AFG		AL	PEM

END OF SECTION 087100

## SECTION 089516 - WALL VENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Wall vents.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

#### 1.3 WARRANTY

##### A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

##### 1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
- b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

##### 2. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

##### A. Source Limitations: Obtain vents from single source from single manufacturer.

#### 2.2 WALL VENTS (MASONRY VENTS)

##### A. Extruded-Aluminum Wall Vents:

1. Basis of Design: Hohmann & Barnard, Inc.; Extruded Aluminum Brick Vent, Style 'E' as manufactured by Hohmann & Barnard, Inc, Hauppauge, NY or approved equal.

2. Extruded-aluminum louvers and frames, not less than 0.125-inch nominal thickness, assembled by welding; with 18-by-14-mesh, aluminum insect screening on inside face; incorporating weep holes, continuous drip at sill, and integral waterstop on inside edge of sill; of load-bearing design and construction.
3. Dampers: Aluminum blades and frames mounted on inside of wall vents; operated from exterior with Allen wrench in socket-head cap screw. Fabricate operating mechanism from Type 304 stainless steel components.
4. Size: 16 inches by 8 inches, nominal.
5. Finish: Non-Standard Finish - Kynar Medium Bronze

## 2.3 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B26/B26M, Alloy 319.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

## 2.4 FINISHES

- A. Kynar Medium Bronze

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install according to manufacturer's written instructions.
- B. Locate and place vents level, plumb, and at indicated alignment with adjacent work.
- C. Attach vents securely in place using fasteners supplied or approved by manufacturer.
- D. Protect unpainted surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- E. Provide perimeter reveals of uniform width for sealants and joint fillers, where indicated.
- F. Use concealed anchorages.

3.2 ADJUSTING AND CLEANING

- A. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- B. Restore vents damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089516

## SECTION 099113 - EXTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include preparation requirements and application instructions.
- B. Samples: For each type of topcoat product.
- C. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Basis of Design: Sherwin-Williams Company (The) or approved equal.
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

### 2.2 PAINT PRODUCTS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- F. Wood Substrates:
  - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
  - 2. Sand surfaces that will be exposed to view, and remove sanding dust.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

### 3.3 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
  - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
  - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  - 3. Allow empty paint cans to dry before disposal.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 EXTERIOR PAINTING SCHEDULE

- A. Cement Board Substrates (Engineered Wood Panel & Trim):

1. High-Build Latex System MPI EXT 3.3H: Dry film thickness of not less than 10 mils.
  - a. Prime Coat: As recommended in writing by topcoat manufacturer.
  - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
  - c. Topcoat: Latex, exterior, high build, MPI #40.
- B. Galvanized-Metal Substrates (Hollow Metal Doors & Frames, Bollards):
  1. Water-Based Light Industrial Coating System MPI EXT 5.3J:
    - a. Prime Coat: Primer, galvanized, water based, MPI #134.
    - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

END OF SECTION 099113

## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Primers.
  - 2. Water-based finish coatings.
- B. Related Requirements:
  - 1. Section 099600 "High-Performance Coatings" for tile-like coatings.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include preparation requirements and application instructions.
  - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Paints; PPG Industries, Inc.
  - 3. Sherwin-Williams Company (The).
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. Colors: As indicated in a color schedule.

2.3 PRIMERS

- A. Interior/Exterior Latex Block Filler: Water-based, high-solids, emulsion coating formulated to bridge and fill porous surfaces of exterior concrete masonry units in preparation for specified subsequent coatings.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, or approved equal:

- a. Basis of Design: Sherwin-Williams Company (The):

- 1) Lexon Block Surfacers A24W00200/ A24WQ8200, or approved equal.

- B. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, or approved equal:

- a. Basis of Design: Sherwin-Williams Company (The):

- 1) Pro Industrial Pro-Cryl Universal Primer #B66W310, or approved equal.

## 2.4 WATER-BASED FINISH COATS

- A. Interior, Water-Based Light-Industrial Coating, Semigloss: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.

1. Basis of Design: Sherwin-Williams Company (The).

- a. Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, #K46W00151, or approved equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Masonry (Clay and CMUs): 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### 3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
  - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
  - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  - 3. Allow empty paint cans to dry before disposal.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
  - 1. Water-Based Light-Industrial Coating System – EP3:
    - a. Block Filler: Interior/exterior latex block filler.
    - b. Intermediate Coat: Matching topcoat.
    - c. Topcoat: Interior, water-based, light-industrial coating, semigloss.
- B. Galvanized-Metal Substrates:

1. Water-Based Light-Industrial Coating System – EP2:
  - a. Prime Coat: Cementitious galvanized primer.
  - b. Intermediate Coat: Matching topcoat.
  - c. Topcoat: Interior, water-based, light-industrial coating, semigloss.

END OF SECTION 099123

## SECTION 099611 - HIGH-PERFORMANCE COATINGS (PROPRIETARY SPECIFICATION)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems.
  - 1. Interior Substrates:
    - a. CMUs.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on actual substrate material to be coated, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Use same designations indicated on Drawings and in Exterior High-Performance Coating Schedule and Interior High-Performance Coating Schedule. Include color designations and product runs (batch numbers).

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, (batch number) that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.6 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. Sherwin-Williams Company (The).
  - 3. Tnemec Company, Inc.

### 2.2 HIGH-PERFORMANCE COATINGS

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  - 3. Products shall be of same manufacturer for each coat in a coating system.
- B. Colors: As indicated in color schedule.

### 2.3 BLOCK FILLERS

- A. Epoxy Block Filler: Solvent-based, two-component, epoxy, high-solids coating; formulated to bridge and fill porous surfaces of CMUs in preparation for specified intermediate and topcoat coatings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, or approved equal:

- a. Sherwin-Williams Company (The).

- 1) Kem Cata-Coat HS Epoxy Filler/ Sealer B42W00400/B42V00401.

## 2.4 EPOXY COATINGS

- A. Epoxy, Semigloss: Solvent-based, two-component, epoxy coating; formulated for resistance to incidental splash and spillage of dilute (5 percent) sulfuric acid, (15 percent) hydrochloric acid, (20 percent) sodium hydroxide, gasoline, and heavy-duty cleaners and detergents; for use on wall and floor surfaces in moderate to heavy traffic commercial and moderate industrial environments.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, or approved equal:

- a. Sherwin-Williams Company (The).

- 1) Macproxy 646 Fast Cure Epoxy.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. CMUs: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted.

1. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed.
  3. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
- D. Masonry Substrates: Remove efflorescence and chalk.
1. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
  2. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.

### 3.3 APPLICATION

- A. Apply high-performance coatings in accordance with manufacturer's written instructions.
1. Use applicators and techniques suited for coating and substrate indicated.
  2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

- C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

### 3.5 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

#### A. CMU Substrates – EP1:

- 1. Epoxy System for Wet Environments:
  - a. Block Filler: Block filler, epoxy.
  - b. Intermediate Coat: Epoxy, matching topcoat.
  - c. Topcoat: Epoxy, semigloss.

END OF SECTION 099611

## SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

### 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 room-identification signs that are directly attached to the building.

#### 1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Room-Identification Signs: Full-size Sample.
  - 2. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. APCO Graphics, Inc.
    - b. ASI Sign Systems, Inc.
    - c. inpro Corporation.
  - 2. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    - b. Surface-Applied Graphics: Applied paint.
    - c. Color(s): As selected by Architect from manufacturer's full range.
  - 3. Sign-Panel Perimeter: Finish edges smooth.

- a. Edge Condition: Square cut.
  - b. Corner Condition in Elevation: Square.
- 4. Mounting: Manufacturer's standard method for substrates indicated Surface mounted to wall with concealed anchors.
  - 5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

## 2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Use concealed fasteners and anchors unless indicated to be exposed.
  - 2. For exterior exposure, furnish nonferrous-metal or hot-dip galvanized devices unless otherwise indicated.
  - 3. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

### 3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

## SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments.

B. Related Requirements:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Solid-plastic toilet compartments:
  - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment.

D. Samples for Verification: Actual sample of finished products for each type of toilet compartment, hardware, and accessory.

1. Size: Manufacturer's standard size.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

#### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For toilet compartments.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Door Hinges: One hinge(s) with associated fasteners.
  - 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
  - 3. Door Bumper: One bumper(s) with associated fasteners.
  - 4. Door Pull: One door pull(s) with associated fasteners.
  - 5. Fasteners: 10 fasteners of each size and type.

#### 1.5 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

### PART 2 - PRODUCTS

#### 2.1 SOURCE LIMITATIONS

- A. Obtain plastic toilet compartments from single source from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- B. Structural Performance: Where grab bars are mounted on toilet compartments, design panels to comply with the following requirements:
  - 1. Panels are able to withstand a concentrated load on grab bar of at least 250 lbf applied at any direction and at any point, without deformation of panel.
- C. Regulatory Requirements: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

#### 2.3 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ASI Accurate Partitions.
  - 2. Knickerbocker Partition Corporation.
  - 3. Scranton Products.
- B. Toilet-Enclosure Style: Overhead braced Floor anchored.

- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color throughout thickness of material. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
  - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  - 2. Heat-Sink Strip: Manufacturer's continuous, extruded-aluminum or stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
  - 3. Color: One color in each room.
- E. Urinal-Screen Construction: Matching panel construction.
- F. Pilaster Shoes: Manufacturer's standard design; stainless steel.
- G. Pilaster Sleeves (Caps): Manufacturer's standard design; stainless steel.
- H. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

## 2.4 HARDWARE AND ACCESSORIES

- A. Door Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty institutional operating hardware and accessories.
  - 1. Hinges: Manufacturer's minimum 0.062-inch-thick, stainless steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through bolts.
  - 2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at toilet enclosures designated as accessible. Mount with through bolts.
  - 3. Coat Hook: Manufacturer's heavy-duty, combination cast stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
  - 4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast stainless steel bumper at outswinging doors. Mount with through bolts.
  - 5. Door Pull: Manufacturer's heavy-duty, cast stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at toilet enclosures designated as accessible. Mount with through bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match items they are securing, with theft-resistant-type heads. Provide sex-type bolts for

through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.5 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.

## 2.6 FABRICATION

- A. Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet enclosures and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for toilet enclosures designated as accessible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:

- a. Pilasters and Panels or Screens: 1/2 inch.
  - b. Panels or Screens and Walls: 1 inch.
- 2. Full-Height (Continuous) Brackets: Secure panels or screens to walls and to pilasters with full-height brackets.
  - a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
  - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.

### 3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware in accordance with hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102113.19

## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### 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. Public-use washroom accessories.
  - 2. Warm-air dryers.
  - 3. Childcare accessories.

#### 1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Include electrical characteristics.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.
  - 2. Identify accessories using designations indicated.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, visible silver spoilage defects.
  - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials:
  - 1. T7 - Soap Dispensers.

2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. T9 - Toilet Tissue (Double Roll) Box Type Dispenser:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
    - a. Basis of Design: Bradley Corporation; 5402.
  - 2. Description: Double-roll dispenser.
  - 3. Mounting: Surface mounted.
  - 4. Operation: Dual roll toilet paper cabinet with retaining mechanism that prevents use of spare roll until first roll is gone.
  - 5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
  - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. T50 - Waste Receptacle:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
    - a. Basis of Design: Bradley Corporation; 356-35.
  - 2. Mounting: Surface mounted with hinged cover.

3. Minimum Capacity: 16.5 gallon.
4. Material and Finish: Stainless steel, No. 4 finish (satin).
5. Liner: Reusable vinyl liner.
6. Lockset: Tumbler type for waste receptacle.

D. T1, T2, T3 - Grab Bar:

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
  - a. Basis of Design: Bradley Corporation; series 812.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
  - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

E. T-17 - Sanitary-Napkin Disposal Unit:

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, or approved equal:
  - a. Basis of Design: Bradley Corporation; Series 4781-15.

F. T16 - Seat-Cover Dispenser:

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, or approved equal:
  - a. Basis of Design: Bradley Corporation; Series 5831.
2. Mounting: Surface mounted.
3. Minimum Capacity: 250 seat covers.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type.

G. T4 - Mirror Unit:

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
  - a. Basis of Design: Bradley Corporation; series 781-62.
2. Frame: Stainless-steel channel.
  - a. Corners: Welded and ground smooth.

3. Tempered glass.
4. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
  - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
5. Size: As indicated on Drawings.

## 2.4 WARM-AIR DRYERS

- A. Source Limitations: Obtain warm-air dryers from single source from single manufacturer.
- A. T40 - Warm-Air Dryer:
  1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
    - a. Basis of Design: Bradley Corporation; 2902-2800.
  2. Description: Standard-speed, warm-air hand dryer.
  3. Mounting: Surface mounted, with low-profile design.
  4. Operation: Electronic-sensor activated with timed power cut-off switch.
    - a. Operation Time: 12 - 15 seconds.
  5. Cover Material and Finish: Cast iron, with enamel finish in color selected by Architect.
  6. Electrical Requirements: 100-120 V, 9.5-4.8 A, 150W.

## 2.5 CHILDCARE ACCESSORIES

- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.
- B. T24 - Diaper-Changing Station:
  1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:
    - a. Basis of Design: Bradley Corporation; 9632
  2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
    - a. Engineered to support minimum of 100-pounds static load when opened.
  3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
  4. Operation: By pneumatic shock-absorbing mechanism.
  5. Hinge: Full-length steel hinge pin and concealed gas shock.
  6. Accessories: Dual integrated paper liner dispensers, molded-in graphics, integral bag hook and safety strap with unbreakable buckle.
  7. Material and Finish: Molded bacterial-resistant, high density polyethylene in cream finish.

## 2.6 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.7 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

#### 1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - b. Kidde; Carrier Global Corporation.
    - c. Larsen's Manufacturing Company.
  - 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
  - 3. Valves: Manufacturer's standard.
  - 4. Handles and Levers: Stainless steel.
  - 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- C. Purple-K Dry-Chemical Type in Aluminum Container: UL-rated 30-B:C, 5-lb nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

### 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
  - 1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
  - 2. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
    - a. Orientation: Vertical.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
  - 1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

## SECTION 123616 - METAL COUNTERTOPS

### 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. Stainless-steel countertops.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal fabrications.
  - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
  - 2. For countertops, show locations and sizes of cutouts and holes for items installed in metal countertops.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products only after casework and supports on which they will be installed has been completed in installation areas.
- B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

#### 1.5 FIELD CONDITIONS

- A. Field Measurements: Where products are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where products are indicated to fit to other construction, establish dimensions for areas where products are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## PART 2 - PRODUCTS

### 2.1 STAINLESS-STEEL FABRICATIONS

- A. Countertops: Fabricate from 0.062-inch-thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch over the base cabinets.
  - 1. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.
  - 2. Weld shop-made joints.
  - 3. Sound deaden the undersurface with heavy-build mastic coating.
  - 4. Extend the top down to provide a 1-inch-thick edge with a 1/2-inch return flange.
  - 5. Form the backsplash coved to and integral with top surface, with a 1/2-inch-thick top edge and 1/2-inch return flange.
  - 6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.

### 2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
- B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 079200 "Joint Sealants" and the following:
  - 1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
  - 2. Color: Clear.

### 2.3 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.
- B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
- C. Secure countertops to steel wall mounted support brackets.
- D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- E. Seal junctures of countertops, splashes, and walls with sealant for countertops.

### 3.3 CLEANING AND PROTECTION

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 123616

**DIVISION 22**  
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## SECTION 220010 – PLUMBING PROVISIONS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Plumbing Contractor, all sub-contractors, and all material suppliers.

#### 1.2. SCOPE OF WORK

- A. This DIVISION requires the furnishing and installing of complete functioning Plumbing systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. In case of an inconsistency between the Drawings and Specifications or within either document, the better quality or the greater quantity of work shall be provided in accordance with the Architect or Engineer's interpretation.
- C. Refer to Architectural, Structural and Electrical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping and ductwork in the manner anticipated in the design.

#### 1.3. SPECIFICATION FORM AND DEFINITIONS

- A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, EMAIL admin@pkmreng.com.
- B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.
- C. When a word, such as "proper", "satisfactory", "equivalent", and "as directed", is used, it requires the Architect-Engineer's review.
- D. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
- E. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
- F. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
- G. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
- H. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.
- I. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.
- J. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

#### 1.4. QUALIFICATIONS

- A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

#### 1.5. LOCAL CONDITIONS

- A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

#### 1.6. CONTRACT CHANGES

- A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.

#### 1.7. LOCATIONS AND INTERFERENCES

- A. Locations of equipment, piping and other plumbing work are indicated diagrammatically by the plumbing drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.
- B. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.
- C. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.
- D. Do not scale mechanical, plumbing and electrical drawings for dimensions. Contractor shall accurately layout work from the dimensions indicted on the Architectural drawings unless they are found to be in error.

#### 1.8. PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.
- B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of plumbing systems by Owner.

#### 1.9. WARRANTY

- A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
- B. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

#### 1.10. ALTERNATES

- A. Refer to General Requirements for descriptions of any alternates that may be included.

#### 1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

- A. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
- C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
- D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.
- E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
- F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.
- G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in plumbing or electrical service requirements necessary

to accommodate such substitution.

- H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

#### 1.12. ELECTRONIC PLAN FILES

- A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of \$50 per sheet, \$100 minimum and \$25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

#### 1.13. OPENINGS, ACCESS PANELS AND SLEEVES

- A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.
- B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

#### 1.14. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS

- A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

#### 1.15. EXTENT OF CONTRACT WORK

- A. Provide plumbing systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of plumbing systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.
- B. Contractor shall become familiar with equipment provided by other contractors that require plumbing connections and controls.
- C. Electrical work required to install and control plumbing equipment, which is not shown on plans or specified under Division 26, shall be included in Contractor's base bid proposal.
- D. All automatic temperature control devices shall be mounted as indicated in automatic temperature control section of specifications.
- E. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which was not used for basis of design as outlined in specifications shall be paid for by Plumbing Contractor at no cost to Owner or Architect-Engineer.
- F. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of plumbing and electrical equipment are made to attain intended control sequences and system operation.
- G. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.
- H. Contractor shall obtain complete electrical data on plumbing shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of plumbing equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

#### 1.16. WORK NOT INCLUDED IN CONTRACT

- A. Consult Division 21, 23, and 26 of specifications for work to be provided by Electrical Contractor in conjunction with installation of plumbing equipment.

#### 1.17. CODES, RULES AND REGULATIONS

- A. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.

- B. Conform to latest editions and supplements of following codes, standards or recommended practices.
- C. BUILDING CODES:
  - 1. International Codes (Latest adopted version of applicable codes)
- D. SAFETY CODES:
  - 1. National Electrical Safety Code Handbook H30 - National Bureau of Standards.
  - 2. Occupational Safety and Health Standard (OSHA) - Department of Labor.
- E. NATIONAL FIRE CODES:
  - 1. NFPA No. 54 Gas Appliance & Gas Piping Installation
  - 2. NFPA No. 70 National Electrical Code
  - 3. NFPA No. 89M Clearances, Heat Producing Appliances
  - 4. NFPA No. 204 Smoke & Heating Vent Guide
- F. UNDERWRITERS LABORATORIES INC:
  - 1. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.
- G. MISCELLANEOUS CODES:
  - 1. ANSI A117.1 - Handicapped Accessibility
  - 2. Applicable State Boiler Codes
  - 3. Americans with Disabilities Act (ADA)
- H. ENERGY EFFICIENCY REQUIREMENTS:
  - 1. All plumbing systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 – 2007 and latest adopted version of IECC.

#### 1.18. STANDARDS

- A. Drawings and specifications indicate minimum construction standard. Should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

#### 1.19. PERMITS/FEES

- A. The Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.
- B. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

### PART 2 - PRODUCTS

#### 2.1. Not Used

### PART 3 - EXECUTION

#### 3.1. SUBMITTALS

- A. Contractor shall furnish submittals of all materials and equipment required by the specifications. Refer to each specification section for the submittals (if any) required for that section.
- B. Submittal format shall be as indicated below. Submittals not meeting these requirements will be returned without action for re-submittal.
  - 1. Submittals shall be furnished in an Adobe PDF format.
  - 2. Submittals shall be per individual submittal section, as listed in the table of contents. All required submittals within that section shall be grouped together in a single submittal.
    - a. Furnishing submittals by division or by individual item may result in delayed reviewing of the submittal(s) due to additional administrative time required to process the large size and/or quantity of files.

3. Submittals shall have a cover page containing the following information: The project name, the applicable specification section and paragraph, the submittal date, and the Contractor's stamp (see below for requirements).
  4. Mark each submitted item as applicable with scheduled mark, name, etc. corresponding to the plans.
  5. Where generic catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Each catalog sheet shall bear the equipment manufacturer's name and address.
  6. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization.
  7. All submittals on materials and equipment listed by UL shall indicate UL approval on submittal.
- C. Contractor review:
1. Contractor shall check all submittals to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All submittals submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All submittals not meeting Contractor's approval shall be returned to their supplier for re-submittal.
  2. No submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.
  3. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- D. Review Schedule:
1. The shop drawing / submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required.
  2. Submittal of all shop drawings as soon as possible after permitting approval but before construction starts is preferred.
  3. Approval of shop drawings submitted prior to receipt of a permit for that respective scope of work should be considered conditional pending review/approval of the construction documents by the AHJ. Changes required to the submittal as a result of permitting comments received after architect's/engineer's review shall not be a justification for a change in price.
  4. Any time delay caused by correcting and re-submitting submittals/shop drawings will be the Contractor's responsibility.
- E. The Architect's-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.
- F. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.
- G. Submittals that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.
- H. Coordination
1. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

### 3.2. SHOP DRAWINGS

- A. Shop drawings shall meet all of the above requirements for submittals.
- B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
- C. No work shall be fabricated until Architect-Engineer's review has been obtained.

- D. Plumbing shop drawings for pipe fabrication shall be a minimum of 1/4" scale. Provide drawings where the complexity of the system or confines of the space require coordination with construction and other trades. Plumbing shop drawings shall not be a reproduction of the contract document and shall show details of the following: Plans, elevations above finished floor, sections, components, insulation and attachments to other work. Plumbing layout indicating sizes on plans, fittings, insulation, clearances, penetrations through fire-rated and other partitions, hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and attachment.

### 3.3. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)

- A. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
- B. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
- C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:
  - 1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
  - 2. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
  - 3. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
  - 4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of plumbing system.
- D. Provide brochures bound in three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
  - 1. Project name and address.
  - 2. Section of work covered by brochure, i.e., "Plumbing", etc.

### 3.4. RECORD DOCUMENTS

- A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
- B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
- C. Provide one copy of on high quality heavy weight presentation type paper. Media which fade shall not be used.
- D. Provide one electronic scanned version of record documents in Adobe PDF format – PDFs may be submitted on electronic media (DVD, USB) or via an FTP or other file sharing site. Provide electronic copies in conjunction with hard copy documents.

### 3.5. CLEANING UP

- A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
- B. Contractor shall clean up all ductwork and equipment at the completion of the project.
- C. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

### 3.6. WATERPROOFING

- A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
- B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

### 3.7. CUTTING AND PATCHING

- A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or

drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.

- B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
- C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of plumbing work shall be repaired at Contractor's expense to approval of Architect-Engineer.

### 3.8. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
- B. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
- C. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
- D. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Plumbing contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
- E. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
- F. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect-Engineer for review before proceeding with fabrication or installation.

### 3.9. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

- A. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner's operating personnel shall be present during these operations.
- B. Contractor shall be responsible for training Owner's operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.
- C. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

### 3.10. FINAL CONSTRUCTION REVIEW

- A. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

**END OF SECTION 220010**

## SECTION 220011 – BASIC PLUMBING MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Provide documentation of all completed tests described herein and their results.

### PART 2 – PRODUCTS (NOT APPLICABLE)

### PART 3 - EXECUTION

#### 3.1. TESTING PROCEDURES FOR PIPING SYSTEMS

- A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
- B. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.
- C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
- D. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
- E. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
- F. For test pressure schedules see Section 221100 of this specification.

#### 3.2. TEST METHODS AND PRESSURES

- A. Test methods and pressures shall be as follows:
  - 1. Hydrostatic Test (Closed Systems):
    - a. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.
  - 2. Hydrostatic Test (Open System):
    - a. Test entire system with 10-foot head of water. Where system is tested in sections each joint in building except uppermost 10 feet of system shall be submitted to at least 10-foot head of water. Water shall be held in system for 15 minutes before inspection starts. System shall hold test pressure without leaks.
  - 3. Pneumatic Test:
    - a. Test entire system with compressed air. Systems operating above 25 PSI shall be tested at 75 PSI or 15% of operating pressure or whichever is greater.
    - b. Allow at least 1 hour after test pressure has been applied before making initial test.
    - c. Curing test, completely isolate entire system from compressor or other sources of air pressure.
  - 4. Pressure Relief and Safety Valve:
    - a. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
    - b. Tag items that pass test with date of test, observed relief pressure setting and inspector's signature.
    - c. Items installed in systems without test tag attached will be rejected.

#### 3.3. STERILIZATION OF DOMESTIC WATER SYSTEMS

- A. After final pressure testing of distribution system thoroughly flush entire system with water until free of dirt and construction debris. Fill system with solution of liquid chlorine or hypochlorite of not less than 50 PPM. Retain treated water in system until test indicates non-spore-forming bacteria have been destroyed or for 24 hours whichever is greater.

- B. All points in systems shall have at least 10 PPM of solution at end of retention period. Open and close each valve at least six times in system during sterilization process to sterilize valve parts.
- C. When time and concentration conditions have been met, drain system and flush with fresh domestic water until residual cleaning solution is less than 1.0 PPM. Open and close each valve in system six times during flushing operation.
- D. Test samples taken from several points in system shall indicate absence of pollution for two full days. Repeat sterilization as required. Acceptance of system will not be given until satisfactory bacteriological results are obtained.

#### 3.4. CLEANING OF SYSTEMS AND EQUIPMENT

- A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:

#### 3.5. MAINTENANCE OF SYSTEMS

- A. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
- B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
- C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as determine by Equipment Manufacturer's recommendations.

#### 3.6. PAINTING OF MATERIALS AND EQUIPMENT

- A. Paint all exterior piping with (2) two coats of an enamel rust inhibiting exterior paint in a color selected by architect.
- B. Touch-up painting and refinishing of factory applied finishes shall be by Plumbing Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
- C. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
- D. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
- E. Where extensive refinishing is required equipment shall be completely repainted.

#### 3.7. PIPING IDENTIFICATION

- A. Provide pipe markers at 10'-0" maximum spacing to identify piping in mechanical rooms and 20'-0" maximum spacing in all other areas with Seaton Setmark pipe markers with letters and flow direction arrows.
- B. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval list of colors and wording prior to purchase of pipe markers.
- C. Pipe marker nomenclature/colors shall meet applicable ANSI Standard and OSHA requirements.

#### 3.8. VALVE IDENTIFICATION

- A. Mark all valves with Seton No. 300-BL brass identification tags with system legend, valve number and size stamped on tag. Lettering shall be black ½" high. Tags shall be minimum 2" in diameter and attached to valve with Seton No. 16 brass jack chain.
- B. Prepare four copies of typewritten list of valve tags. List shall be typed in upper case and contain tag number, valve size, type, function and location. Frame one list under glass and mount near operating instruction in main equipment rooms.

#### 3.9. EQUIPMENT LABELS:

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware. Black letters on white background.
- B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- C. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- D. Fasteners: Stainless-steel rivets or self-tapping screws.
- E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- F. 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.

### 3.10. EXCAVATION AND BACKFILL

- A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
- C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.
- D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
- E. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

### 3.11. FIRE BARRIERS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. SUBMITTALS
  - 1. Product Data: For each type of product indicated.
  - 2. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
    - a. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
    - b. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
  - 3. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
    - a. Types of penetrating items.
    - b. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
    - c. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
- C. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
- D. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- E. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- F. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.
- G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
- H. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- I. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.
- J. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers

recommendations.

1. Equivalent by Hilti, Inc., Johns Manville, Nelson Firestop Products, NUCO Inc., RectorSeal Corporation, Specified Technologies Inc., 3M, Tremco, USG, Dow, Chemelex.

### 3.12. EQUIPMENT ANCHORS

- A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
- B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
- C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.

### 3.13. WELDING

- A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
- B. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.
- C. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders' code, date and types of latest qualification test passed by each welder.
- D. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.
- E. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

**END OF SECTION 220011**

## SECTION 220013 – PROJECT COORDINATION

### 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 administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Administrative and supervisory personnel.
  - 3. Project meetings.
  - 4. Requests for Interpretation (RFIs).
- B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

#### 1.3. COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Delivery and processing of submittals.
  - 2. Progress meetings.
  - 3. Preinstallation conferences.
  - 4. Project closeout activities.
  - 5. Startup and adjustment of systems.

#### 1.4. SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
  - 1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
    - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate required installation sequences.
    - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  - 2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.

3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

#### 1.5. COORDINATION

- A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.
- B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
- C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
- D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
- E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.
- F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
- G. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.
- H. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.
- I. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.
- J. Adjust location of piping, ductwork, conduit, wiring, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

##### 1. Right-of-Way:

- a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
- b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

#### 1.6. DRAWINGS AND FILES

- A. The Drawings show only the general run of MEP systems, equipment, fixtures, piping and ductwork and other components as well as approximate location of items such as outlets, switches, diffusers, lights, and equipment connections, etc. Coordinate all exact locations of items with other trades, architectural elevations, equipment requirements, owner requirements, ceilings, access, serviceability, etc. All such modifications and coordination shall be made without additional cost to the Owner. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made
- B. Wherever the work is of sufficient complexity, additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field. Attend meetings with other trades to review all documents.
- C. When directed by the General Contractor for areas of necessary coordination provide 3D building modelling coordination files and documents with other trades. Transmit information electronically and attend meetings as directed by the G/C as well as take part in coordination activities and documentation. Contractor shall be required to generate their own electronic files for this process.

### 1.7. PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
  - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Possible conflicts.
    - i. Compatibility problems.
    - j. Time schedules.
    - k. Manufacturer's written recommendations.
    - l. Warranty requirements.
    - m. Compatibility of materials.
    - n. Space and access limitations.
    - o. Regulations of authorities having jurisdiction.
    - p. Testing and inspecting requirements.
    - q. Installation procedures.
    - r. Coordination with other work.
    - s. Required performance results.
    - t. Protection of adjacent work.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  - 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.
    - b. Review present and future needs of each contractor present, including the following:
      - i. Interface requirements.

- ii. Sequence of operations.
  - iii. Status of submittals.
  - iv. Deliveries.
  - v. Off-site fabrication.
  - vi. Access.
  - vii. Quality and work standards.
  - viii. Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8. REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.
  1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

3.1. EQUIPMENT FURNISHED BY OTHERS

- A. Description:
  1. Items furnished by other trades (electrical contractor, etc.) such as disconnect switches, etc.
  2. Kitchen Equipment (may be furnished by owner, owner's vendor, or separate sub-contractor)
  3. Equipment furnished by general contractor
  4. Equipment furnished by owner
- B. General
  1. Fully review manufacturer's installation instructions for equipment. Installation of all related plumbing items shall be per same.
    - a. Plumbing contractor shall obtain same from others if not readily available.

**END OF SECTION 220013**

## SECTION 220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### PART 2 - PRODUCTS

#### 2.1. MOTORS

- A. Motors shall be installed in strict accordance with rules set forth by NEC and equipment manufacturer.
- B. ELECTRIC MOTORS (Less than ½ HP)
  - 1. Motors 1/3 horsepower and smaller shall be selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
  - 2. Motors shall have a minimum service factor of 1.15 for open dripproof enclosure and 1.00 for totally enclosed motors. Wherever applicable provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
  - 3. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 0 degrees C (32°F) to 140°C (104°F) at altitudes below 3300 feet.
  - 4. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All other shall have automatic reset protectors.
  - 5. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
  - 6. Motor bolts, screws and other external hardware shall be treated with corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with a durable machinery enamel.
  - 7. Unless indicated otherwise motors shall be rated for continuous operation at 115, 200, or 277 volt single phase 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shaded pole motors.
  - 8. Motor leads shall be marked throughout entire length for easy identification and terminate with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
- C. ELECTRIC MOTORS (1/2 HP and Larger)
  - 1. Provide equipment requiring electric motors with NEMA Standard motors. Shop drawings, submitted and equipment provided with electric motors shall include motor manufacturer, horsepower, voltage, full load amperes, NEMA design type, insulation class, shaft bearing type, mounting base type, and enclosure type. To greatest extent possible motors for this project shall be by one manufacturer.
  - 2. Motors shall conform to current NEMA Standard MG1. Motor shall operate successfully without derating under the following conditions.
  - 3. 40 degrees C (104°F) maximum ambient temperature, 3,300 Ft. maximum altitude, voltage variations of plus or minus 10% of nameplate rating, frequency variations of plus or minus 5% of nameplate rating, combined voltage and frequency variation of plus or minus 10% total as long as frequency does not exceed plus or minus 5%.
  - 4. Motors shall meet or exceed locked rotor (Starting) and breakdown (maximum) torques specified for the NEMA design rating. Lock rotor currents shall not exceed NEMA maximum values for motor NEMA design rating.
  - 5. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
  - 6. Unless indicated otherwise, motor insulation may be manufacturers standard for Class A, B or F provided that maximum permissible temperature for insulation is not exceeded when motor is operating at its service factor load in a 40 Degrees C (104°F) ambient.
  - 7. Motor frame/HP relationship shall conform to current NEMA Standard for "T" frames. Motors shall have antifriction ball or roller bearings sized for average life of at least 100,000 hours under normal v-belt loading conditions. Bearings shall be AFBMA Standard and shield mounted ball bearings of ample capacity for motor rating. Bearing housing shall have provisions for adding new lubricant and draining out old lubricant without major motor disassembly. Bearing housing shall have seals to protect bearing from entrance of foreign matter and to prevent leakage of bearing lubricant.
  - 8. Conduit box mounting shall rotate to allow conduit entrance from top, bottom or either side. Conduit

- holes shall conform to NEC Standards.
9. Motor leads shall have same insulation class as motor windings. Leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
  10. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating. Motor enclosure shall be prime painted with corrosion resisting metal primer and finished with a durable machinery enamel paint.
  11. Unless indicated otherwise motors shall be rated for continuous operation at rated voltage, three phase, 60 hertz. Motors shall be T-frame squirrel cage induction. Type NEMA design B with Class B insulation. Motors shall be dripproof totally enclosed or explosion-proof as required by motor environment.

PART 3 – EXECUTION (NOT APPLICABLE)

**END OF SECTION 220513**

## SECTION 220514 – MOTOR CONTROL AND EQUIPMENT DISCONNECTS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of disconnect to be furnished.
- B. Dimensional Drawings: For each respective type and size of disconnect.

### PART 2 - PRODUCTS

#### 2.1. MANUFACTURERS

- A. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.

#### 2.2. DISCONNECT SWITCHES

- A. Provide heavy-duty horsepower rated Safety Switches rated in accordance with NEMA enclosed Switch Standard KS 1-1969 and L98 Standard.
- B. Enclosure shall be NEMA type and material required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
- C. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have movable contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and shall be integral part of box. All current carrying parts shall be plated.
- D. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.

#### 2.3. MOTOR STARTERS - GENERAL

- A. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.

#### 2.4. MAGNETIC MOTOR STARTERS

- A. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
- B. Enclosures shall be NEMA type required by starter location and environment.
- C. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.
- D. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.
- E. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
- F. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.
- G. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.
- H. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.
- I. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.
- J. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.

## 2.5. COMBINATION MAGNETIC MOTOR STARTERS

1. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
2. Starter NEMA enclosure type shall be type required for starter location and environment.
3. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
4. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.
5. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.
6. See plans for combination magnetic starters.

## 2.6. MANUAL MOTOR CONTROL (1 HP Maximum)

- A. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.
- B. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
- C. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.
- D. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.

## PART 3 EXECUTION

### 3.1. INSTALLATION

- A. All fuse holders shall have rejection clips installed.
- B. Mount starter enclosure rigidly and with proper alignment on building structure or steel supports with operating switches not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
- C. Furnish and install a nameplate for each starter/switch engraved with the equipment designation which the disconnect serves.
- D. All starters/disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.
- E. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and manufacturer's installation requirements.

**END OF SECTION 220514**

## SECTION 220523 – VALVES

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. EQUIVALENTS

- A. Equivalent valves shall be used only from the following specified valve manufacturers and listed on current comparison charts by Apollo, Hammond, Hays, Milwaukee, Muessco, Nibco, Rockwell-Nordstrom, Stockham, and Watts.

#### 1.3. SUBMITTALS

- A. Product Data: For each type of valve indicated.

#### 1.4. QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service and NSF 372 for lead content.

### PART 2 - PRODUCTS

#### 2.1. GENERAL REQUIREMENTS FOR VALVES

- A. Plumbing valve applications specified in this Section are limited to NPS 12 (DN 300).
- B. Refer to valve schedule articles for applications of valves.
- C. Caution: Revise pressure ratings and insert temperature ratings in valve articles if valves with higher ratings are required.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller[ except plug valves.
  - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- G. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Gate Valves: With rising stem.
  - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: With extended neck.
- H. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Solder Joint: With sockets according to ASME B16.18.
  - 3. Threaded: With threads according to ASME B1.20.1.
  - 4. Grooved: With grooved ends to copper-tube dimensions or similar to AWWA C606.

#### 2.2. VALVES

##### A. BALL VALVES

- 1. Ball valves shall be scheduled as type "BLV" valves. Valve specifications by type number shall be as follows:
- 2. Provide ball handle with extension or offset as required to clear piping insulation.
  - a. BLV-1: 2-1/2" valves and smaller, Hammond #8501 (screwed) or 8511 (solder) series bronze two piece large port ball valve 600 PSI-WOG/150 PSI-WSP reinforced TFE seats, chrome plate brass ball (tunnel or drilled design), silicon bronze stem vinyl-covered steel lever handle. Stainless steel ball and stem shall be provided for steam applications.
  - b. BLV-2: Ball valve shall be flexible lip seat to assure positive shut off (in both directions) and self compensates for wear. Material - fiberglass reinforced teflon, single piece. Self-

adjusting, low friction teflon box ring stem seals pre-loaded by Belleville washers. Two-piece carbon steel body. Four bolt design with locking fasteners for vibration resistance and joint integrity, one piece teflon body seal. Valve shall be rated for 250 PSI steam service. 316 stainless steel ball and stem. Provide with insulated handle. Neles Jamesbury Model 21-2236MT. Equivalent by Worchester. MCF Series 56-HT.

**B. GLOBE VALVES**

1. Globe valves shall be scheduled as type "GLV" valves. Valve specifications by type number shall be as follows:
  - a. GLV-1: 2-1/2" valves and smaller, Hammond #IB413T (screwed) or IB423 (solder) bronze globe valve, 300 PSI-WOG/150 PSI-WSP union bonnet, Teflon disc, malleable iron handwheel.

**C. PLUG VALVES**

1. Plug valves shall be scheduled as type "PLV" valves. Valve specifications by type number shall be as follows:
  - a. PLV-1: 1" valves and smaller Hays 7400 series iron body gas cock, 175 PSI-WOG bronze plug washer and nut, screwed ends.
  - b. PLV-2: 1-1/4" through 4" valves, Rockwell-Nordstrom Fig. 142, semi-steel lubricated plug valve, 175 PSI-WOG coated plug, two bolt cover, and short pattern screwed ends. Provide complete with standard pattern cast handle.

**D. GATE VALVES**

1. Gate valves shall be scheduled as type "GTV" valves. Valve specifications by type number shall be as follows:
  - a. GTV-1: 2" and smaller Hammond #IB640 (screwed) or IB635 (solder) ASTM B 62 bronze body and bonnet with malleable iron handwheel, 200 PSI-WOG/125 PSI-WSP.
  - b. GTV-2: 2 1/2" and larger Hammond #IR1140 HI, flanged, bolted bonnet, O.S. & Y., ASTM 126 iron body, bronze trimmed, 200 PSI-WOG/125 PSI-WSP.

**E. CHECK VALVES**

1. Check valves shall be scheduled as type "SCV" valves. Valve specifications by type number shall be as follows:
  - a. SCV-1: 2" valves and smaller Hammond #IB940 (screwed) or IB912 (solder) bronze check valve, 200 PSI-WOG/125 PSI-WSP, Teflon or bronze disc and seat ring.
  - b. SCV-2: 2-1/2" and larger Hammond #IR1124 HI flanged, ASTM 126 iron body, bronze trimmed, 200PSI-WOG/125 PSI-WSP.

**F. BUTTERFLY VALVES**

1. Butterfly valves shall be scheduled as Type "BFV" valves. Valve specifications by type number shall be as follows:
  - a. BFV-1: Size 3" and larger Hammond #6211-01 (lever) or 6211-03 (gear) ASTM A 126 cast iron drilled and tapped full lug body, 200 PSI-WOG 12" and smaller, 150 PSI-WOG 14" and larger, extended neck, bronze disc, stainless steel stem, field-replaceable EPDM or (buna for oil or lubricated service) sleeve and stem seals.
  - b. BFV-2: Size 3" and larger Victaulic Series 608N (lever or gear), brass cast body to UNS C87850, copper-tube dimensioned grooved ends, 300 PSI CWP, aluminum-bronze disc, stainless steel stem, and pressure responsive fluoroelastomer seat. (Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating.)
2. UL classified in accordance with NSF-61 for potable water service. The system shall meet the low-lead requirements of NSF-372.

**G. MANUAL BALANCING VALVES**

1. Balancing valves shall be scheduled as Type "BAV" valves. Contractor shall provide bronze balancing valves with provisions for connecting differential pressure meter for purposes of setting flow rate through valve. Contractor shall install balancing valves in a manner that allows access to the setting indicator and the gauge connections. Valves shall be shipped in polyurethane block to be used as insulation. Equivalent valves by Armstrong, Bell and Gossett, Tour and Anderson, Nibco. Valves shall be as follows:

- a. BAV-1 Sizes ½" through 6" Armstrong Model CBV I or CBV II circuit balance valve, 125 PSI-WP at 250 degrees F., meter connections with built-in check valves screwed or flanged ends. Provide complete with polyurethane insulation cover.

### 2.3. VALVE SCHEDULE

SYSTEM	SIZE	STOP	CHECK	BALANCE
Domestic Water	½"-2-1/2"	BLV-1	SCV-1	BAV-1
Domestic Water	3" and up	BFV-1 or 2	SCV-2	BAV-1
Pumped Condensate	½"-1-1/2"	--	SCV-1	--
Compressed Air	All	BLV-1	--	--

## PART 3 – EXECUTION

### 3.1. VALVE INSTALLATION

- A. Install valves with unions, grooved joint couplings, 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 swing check valves for proper direction of flow and in horizontal position with hinge pin level.

### 3.2. INSTALLATION

- A. Install necessary valves within piping systems to provide required flow control, to allow isolation for inspection, maintenance and repair of each piece of equipment or fixture, and on each main and branch service loop.
- B. Each valve shall be installed so that it is easily accessible for operation, visual inspection, and maintenance and wherever possible, gate, check and ball valves shall be installed on a horizontal run with the handle upright and within 15 degrees of vertical. Butterfly valves shall be installed with the stem in the horizontal position and the handle at 90 degrees from vertical.
- C. Valves installed in piping systems shall be compatible with system maximum test pressure, pipe materials, pipe joining method, and fluid or gas conveyed in system.
- D. Valves 2-1/2" and smaller shall have soldered, grooved, or screwed end connections as required by piping materials unless otherwise specified or shown on drawings. Install union connection in the line within two feet of each screw end valve unless valve can be otherwise easily removed from line. Valves 3" and over shall have flange or grooved end connections.
- E. Non-rising stem valves shall not be installed at any point in the piping systems. With permission of Architect-Engineer non-rising stem valve may be installed at particular points where space is restricted.
- F. Provide butterfly valves 6" and smaller with 10 position lever handle for on-off application and infinite position handle for throttling applications. Provide butterfly valves 8" and up with fully enclosed all weather gear operators.
- G. Install globe valves with pressure on top of disc except that must be completely drained for inspection, maintenance or to prevent freezing shall be installed with stem in horizontal position to insure complete drainage of pipelines.
- H. Gate valves shall not be installed in pipelines where intended for throttling service or where piping is subject to vibration as part of normal operating conditions.
- I. Valves shall be designed for repacking under pressure when fully opened and backseated.
- J. Balancing valves installed by means of sweating or soldering shall have their interiors removed before installation and reinstalled upon dissipation of the heat associated with installation. Using a wet rag in lieu of removing the valve interior as a means of heat dissipation during installation is not acceptable.

### 3.3. ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

**END OF SECTION 220523**

## SECTION 220700 – PLUMBING INSULATION

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUMMARY

##### A. Section Includes:

- 1. Insulation Materials:
  - a. Cellular glass.
  - b. Flexible elastomeric.
  - c. Mineral fiber.
  - d. Polyolefin.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Sealants.
- 6. Factory-applied jackets.
- 7. Field-applied jackets.
- 8. Tapes.

##### B. SUBMITTALS

- 1. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- 2. Shop Drawings:
  - a. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - b. Detail attachment and covering of heat tracing inside insulation.
  - c. Detail insulation application at pipe expansion joints for each type of insulation.
  - d. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - e. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - f. Detail application of field-applied jackets.
  - g. Detail application at linkages of control devices.
  - h. Detail field application for each equipment type.
- 3. Qualification Data: For qualified Installer.
- 4. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

##### C. QUALITY ASSURANCE

- 1. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- 2. 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.
  - a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- 3. Products shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

### 1.3. DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

### 1.4. COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

### 1.5. SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 PRODUCTS

### 2.1. INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

### 2.2. PIPING AND EQUIPMENT INSULATION

- A. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Cell-U-Foam Corporation; Ultra-CUF.
    - b. Pittsburgh Corning Corporation; Foamglas Super K.
  - 2. Block Insulation: ASTM C 552, Type I.
  - 3. Special-Shaped Insulation: ASTM C 552, Type III.
  - 4. Board Insulation: ASTM C 552, Type IV.
  - 5. If retaining both types of insulation in first two subparagraphs below, indicate where each type applies in insulation system schedules.
  - 6. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
  - 7. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
  - 8. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- B. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- C. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.

- e. Owens Corning; All-Service Duct Wrap.
- D. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Knauf Insulation; Earthwool 1000(Pipe Insulation).
    - b. Johns Manville; Micro-Lok.
    - c. Manson Insulation Inc.; Alley-K.
    - d. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 deg F and Type IV, 1000 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I and IV, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- E. Mineral-Fiber Pipe and Tank Insulation:
  - 1. Products: Subject to compliance with requirements, provide:
    - a. Knauf Insulation; Kwik-Flex Pipe and Tank Insulation. Basis of Design Product.
  - 2. Fiberglass bonded with a thermosetting resin. Semi-rigid blanket material with factory-applied ASJ jacket, complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Compressive Strength; per ASTM C 165, not less than 25 PSF (1.2 kPa) at 10% deformation. Thermal conductivity (k value) at 100 deg. F (38 deg. C) is 0.25 Btu x in. /h x sq. ft. x deg. F (0.036 W/m x C). Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.3. INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

### 2.4. ADHESIVES

- A. Military Specification referenced in this article is the only standard available when this Section was updated. MIL-A-3316C was last updated in October 1987.
- B. 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.
  - 1. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.5. MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.

2. Service Temperature Range: Minus 20 to plus 200 deg F.
3. Solids Content: 63 percent by volume and 73 percent by weight.
4. Color: White.

## 2.6. 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.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 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.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. 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: White.
5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.7. FACTORY-APPLIED JACKETS

### A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. ASJ+ SSL+: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing, interleaving with an outer polymer film leaving no paper exposed, and pressure-sensitive, acrylic-based adhesive covered by removable protective strip; complying with ASTM C 1136, Type I, II, III, IV, VII, VIII, and X
4. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

## 2.8. FIELD-APPLIED FABRIC-REINFORCING MESH

### A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

## 2.9. FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Although other thicknesses for PVC jackets are available, a flame-spread index of 25 and a smoke-developed index of 50 apply only to thicknesses of 30 mils (0.8 mm) and less.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.
- D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
  1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
  2. Factory cut and rolled to size.
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Among the three moisture barriers in first subparagraph below, 1-mil (0.025-mm) barrier provides the least protection against galvanic corrosion, 3-mil (0.075-mm) barrier offers better protection, and Polysurlyn barrier offers the best protection. For most indoor applications, 1-mil (0.025-mm) barrier is adequate. For outdoor applications, select either 3-mil (0.075-mm) or Polysurlyn barrier.
  5. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  6. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper].
  7. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union covers.
    - e. End caps.
    - f. Beveled collars.
    - g. Valve covers.
    - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

#### 2.10. TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Width: 3 inches.
  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.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
  1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches.
2. Film Thickness: 6 mils.
3. Adhesive Thickness: 1.5 mils.
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch in width.

#### 2.11. SECUREMENTS

- 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. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

#### 2.12. INSULATION SCHEDULE

- A. See plans for piping and insulation schedule. Other insulation requirements are scheduled below:

INSULATION SERVICE		SIZE	TYPE	THICKNESS	JACKET
Drinking Fount. Drain		All Sizes	FE	1"	ASJ-SSL
Condensate Drain		All Sizes	FE	1/2"	ASJ-SSL
Roof Drain Bodies		All Sizes	FE	1/2"	ASJ-SSL
MF - Mineral-Fiber	CG - Cellular Glass	FE - Flexible Elastomeric			

#### 2.13. LAVATORIES AND SINK INSULATION

- A. Insulate all exposed hot, cold and waste piping associated with lavatories and sinks with Truebro "Handi Lav-Guard" insulation kit model no. 102. Equivalent by Brocar Products Inc. or Proto P-trap and valve covers.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. 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.

#### 3.3. GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. All portions of piping shall be insulated, including inside walls, chases and other concealed spaced.
- C. 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.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.
- R. Undamaged insulation systems on cold surface piping and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.

### 3.4. PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. 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 Penetration Firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Penetration Firestopping."

### 3.5. EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.

3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.
- 3.6. GENERAL PIPE INSULATION INSTALLATION
- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  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.

### 3.7. CELLULAR-GLASS INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.8. FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.9. MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire, bands or SSL (self sealing lap) closure system 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. If the ASJ jacket is equipped with SSL closure system, use it to seal the longitudinal seam.
  3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.10. FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
  1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
  3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
  4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
  5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### 3.11. FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.12. FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by 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 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, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
- E. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Plumbing Contractors expense at no cost to owner.

**END OF SECTION 220700**

## SECTION 221000 – PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of product to be used.

### PART 2 - PRODUCTS

#### 2.1. PIPING MATERIALS

- A. Piping used throughout project shall conform to the following specifications. Piping shall be plainly marked with manufacturers name and weight. See piping material schedule at end of this Section for materials to be used for each piping system.

1. Cast Iron Bell and Spigot Soil Pipe

- a. Pipe and fittings shall be gray cast iron bell and spigot conforming to ASTM A-74.
- b. Seal joints with neoprene gaskets conforming to ASTM C-564.
- c. Pipe and fittings shall be marked with the CISPI trademark or receive approval of engineer.
- d. Pipe and fittings by AB&I, Charlotte, Star or Tyler

2. Hubless Cast Iron Soil Pipe

- a. Pipe and fittings shall be gray cast iron conforming to CISPI 301.
- b. Pipe joints shall be no-hub heavy duty couplings consisting of neoprene rubber sleeve conforming to ASTM C-564 and mfg. by Husky SD 4000, Clamp all-125 or MG. Equivalent Mission.Heavyweight, Ideal Clamp Product.
- c. Pipe and fittings shall be marked with the CISPI trademark or receive approval of engineer.
- d. Pipe and fittings by AB&I, Charlotte, Star or Tyler

3. Ductile Iron Pipe:

- a. Pipe

- i. Ductile iron shall be ANSI A21.51, AWWA C151. All pipe joints shall be mechanical unless otherwise indicated. Pipe shall be color coded by blotches of paint. The Contractor shall submit a "color class" schedule of the pipe as marked by the manufacturer.
- ii. Inside coating shall be cement-mortar lining with seal coat of bituminous material in accordance with ANSI A21.4.
- iii. American Water Works Associations (AWWA) Standards: C151-86 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for water, or other liquids.
- iv. American National Standards Institute (ANSI): A21.4-1985 Cement mortar lining for gray-iron and Ductile-Iron Pipe and Fittings for water. A21.10-1987 Gray-Iron and Ductile-Iron Fittings, 3 inch through 48 inch for water and other liquids. A21.11-1985 Rubber gasket joints for gray-iron and ductile-iron pressure pipe and fittings. A21.51-1986 Ductile-iron pipe centrifugally cast in metal molds for sand-lined molds for water or other liquids (AWWA C151-1981).

- b. Ductile Iron Pipe Joints and Fittings:

- i. Joints: Ductile iron shall be mechanical joints of the latest approved design of the manufacturer. Joints shall be so designed to guarantee a water-tight joint for the life of the pipeline.
- ii. Fittings: Ductile iron shall be short body mechanical as shown on the drawings, or required of the same pressure design as the pipe. Dimensional control and joint design shall conform to ANSI Standard A21.10 and A21.11. All fittings shall be coated as specified for the pipe. Where rods or ties are shown or called for, fittings shall be provided with anchoring lugs.
- iii. Joint Materials: Ductile Iron Joint: Mechanical joints, bolts, glands, retainer glands and gaskets, ANSI Standard A21.11.

4. Copper Tube:

- a. Tube/Pipe:
    - i. Provide hard temper copper water tube conforming to requirements of current ASTM Specification B-88. Tubing shall be Type K, L, or M as listed in schedule. Tubing joints shall be soldered, brazed or Viega Pro-Press style fittings. See schedule for joining method to be used.
    - ii. Pipe by Anaconda, Cerro, Chase, Mueller or Revere Copper.
  - b. Wrought Copper Fittings:
    - i. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22
    - ii. Fittings by Anaconda, Chase, Viega or Nibco.
  - c. Grooved Joint Fittings: ASME B16.22 wrought copper or cast bronze to ASME B16.18. Manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.) Victaulic Copper Connection.
  - d. Provide Victaulic Installation-Ready Style 607H couplings with grade 'EHP' gasket. Copper-tube dimensions with offsetting, angle-pattern bolt pads.
5. Copper Tube Type ACR:
- a. Pipe/Tube:
    - i. Provide hard temper nitrogenized copper refrigerant tube conforming to requirements of current ASTM B-88. Tubes shall be Type L or K as listed in schedule.
    - ii. Tubing joints shall be brazed.
    - iii. Pipe by Anaconda, Cerro, or Mueller.
  - b. Wrought Copper Fittings:
    - i. Provide wrought solder joint copper tube fitting conforming to ANSI Standard B16.22
    - ii. Fittings by Anaconda, Chase or Nibco.
6. Polyvinyl Chloride Drain Waste Pipe:
- a. Pipe:
    - i. Provide Schedule 40 polyvinyl chloride solid core plastic drain waste and vent pipe conforming to ASTM D2665. Joints shall be properly cleaned, primed and glued where scheduled.
    - ii. Polyvinyl Chloride (PVC) Pipe & Fittings Cell Class 12454 B. ASTM D 2241 SDR-26
    - iii. Pipe by Charlotte, Genova, Crestline or equal.
  - b. PVC Fittings:
    - PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.
    - Joints shall be of a push-on type with a bell-end grooved to receive a synthetic rubber gasket when scheduled. Solvent welded joints are not allowed outside the building. The joint shall be made in accordance with ASTM D 3212.
  - ii. Equivalents: Spears, Lasco or equal.
7. HDPE Below Grade Polyethylene Water Piping:
- a. Provide high density polyethylene pipe listed for use in underground water service applications. Pipe shall be UV stabilized.
  - b. DR 9, ASTM D3035, AWWA C901, NSF
  - c. PE3408/PE3608 material conforming to ASTM D3350 with the cell classification of 345464C/E and is listed with the Plastic Pipe Institute's (PPI) TR4. Formulated with carbon black and ultraviolet stabilizer for maximum protection against UV rays for added assurance.
  - d. Joints shall be fused.

### PART 3 EXECUTION

#### 3.1. PIPING INSTALLATION

- A. Piping systems materials and installation shall conform to the following standards and codes.

1. System: Natural Gas Piping

a. Code: ANSI Standard B31.12 "Fuel Gas Piping"

- B. Natural Gas piping and other fuel piping systems shall be installed per code. All fittings in chases, solid walls, floors, etc. shall be welded, fused or otherwise listed for installation in concealed locations. Other acceptable methods shall include providing ventilated casings for installation in these situations. Unions, elbows, bushings, etc shall not be installed in concealed locations and shall only be installed in accessible locations.
- C. No piping containing water shall be located in areas subject to freezing temperatures, including: unheated attics, unheated plenums, chases wall spaces or cavities within exterior walls, under slabs, or in concrete.
- D. Pipe sizes indicated on plans and as specified refer to nominal size in inches, unless otherwise indicated. Pipes are sized to nearest 1/2". In no case shall piping smaller than size specified be used.
- E. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.
- F. Contractor shall provide and be responsible for proper location of pipe sleeves, hangers, supports, and inserts. Install hangers, supports, inserts, etc., as recommended by manufacturer and as specified and detailed on drawings.
- G. Verify construction types and provide proper hangers, inserts and supports for construction used. Install inserts, hangers and supports in accordance with manufacturers load ratings and provide for thermal expansion of piping without exceeding allowable stress on piping or supports. Provide solid type hangers and supports where pipe travel exceeds manufacturer's recommendations for fixed hanger and supports.
- H. Install piping parallel with building lines and parallel with other piping to obtain a neat and orderly appearance of piping system. Secure piping with approved anchors and provide guides where required to insure proper direction of piping expansion. Piping shall be installed so that allowable stress for piping, valves and fittings used are not exceeded during normal operation or testing of piping system.
- I. Install piping so that systems can be completely drained. Provide piping systems with valve drain connections at all low pipe and ahead of all sectionalizing valves whether shown on plans or not. Drain lines shall be 3/4".
- J. Drain valves on closed piping systems such as chilled water system shall have lock shields and plugged or capped outlets to protect system from inadvertent drainage.
- K. Pitch all piping and where possible make connections from horizontal piping so that air can be properly vented from system. Provide air vents as specified at all system high points and at drop in piping in direction of flow. Use eccentric reducers where necessary to avoid air pockets in horizontal piping.
- L. Provide unions or flanged joints in each pipe line preceding connections to equipment to allow removal for repair or replacement. Provide all screwed and control valves with unions adjacent to each piping connection. Provide screwed end valves with union adjacent to valve unless valve can be otherwise easily removed from line.
- M. Fittings pressures and temperature ratings shall be equal to or exceed maximum operating temperature and working pressure of piping system. No mitered or field fabricated pipe fittings will be permitted.
- N. All pipe threads shall meet ANSI Standard B2.1 for taper pipe threads. Lubricate pipe threads with Teflon thread sealant and lubricating compound applied full strength. Powdered or made-up compound will not be permitted. Pipe thread compound shall be applied only to male pipe threads.
- O. Brazed socket type joints shall be made with suitable brazing alloys. Minimum socket depth shall be sufficient for intended service. Brazing alloy shall be end fed into socket, and shall fill completely annular clearance between socket and pipe or tube. Brazed joints depending solely upon a fillet rather than a socket type joint will not be acceptable.
- P. Soft soldered socket type joints shall be made with sill-floss or 95-5 tin-antimony solder as required by temperature and pressure rating of piping system. Soldered socket-type joints shall be limited to systems containing non-flammable and non-toxic fluids. Soldered socket-type joints shall not be used on piping systems subject to shock vibration. Soldered joints depending solely upon a fillet rather than a socket-type joint will not be acceptable.
- Q. Make changes in piping size and direction with approved factory made fittings. Provide fittings suitable for at least 125 PSI working pressure or of pressure rating required for maximum working pressure of system whichever is greater.

3.2. PIPING SUPPORTS, ANCHORS, SLEEVES AND SEALS

- A. Furnish proper type and size pipe sleeves to General Contractor for installation in concrete or masonry walls or floors. Sleeves are not required for supply and waste piping through wall supporting plumbing fixtures or for cast iron soil pipe passing through concrete slab or grade except where penetrating a membrane waterproof floor.
- B. Plumbing Contractor shall supervise installation of sleeves to insure proper location and installation.
- C. Each sleeve shall be continuous through wall floor or roof and shall be cut flush on each side except where indicated otherwise. Sleeves shall not be installed in structural member except where indicated or approved.
- D. Sleeves passing through above grade floors subject to flooding such as toilet rooms, bathrooms, equipment

rooms and kitchens shall be cast iron with integral flanges and shall extend 1 inch above finished floor. Size sleeves for and seal space between pipe sleeve with Thunderline Link-Seal.

- E. Provide steel pipe sleeves in bearing walls and masonry walls. Opening in non-bearing walls, floors and ceilings may be 20 gauge galvanized pipe sleeves or openings cut with concrete core drill.
- F. Pipe insulation shall run continuous through pipe sleeves with 1/4" minimum clearance between insulation and pipe sleeve. Provide metal jackets over insulated pipes passing through fire walls, floors and smoke partitions. Jacket shall be 0.018 stainless steel extending 12 inches on either side of barrier and secured to insulation with 3/8" wide band. Seal annular space between jacket and pipe sleeves with Thunderline High Temperature Link Seal.
- G. Pipe wall penetrations exposed to view shall have tight fitting escutcheons or flanges to cover all voids around openings.
- H. All below grade and exterior wall penetrations shall be installed in a pipe sleeve and sealed between the pipe and pipe sleeve with Thunderline High Temperature Link Seal.
- I. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around cables with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.
  - 1. Equivalent by Hilti, Inc., Johns Manville, Nelson Firestop Products, NUCO Inc., RectorSeal Corporation, Specified Technologies Inc., 3M, Tremco, USG, Dow, Chemelex.

### 3.3. PIPE HANGERS AND SUPPORTS

- A. Provide and be responsible for locations of piping hangers, supports and inserts, etc., required for installation of piping under this contract. Design of hangers and supports shall conform to current issue of Manufacturers Standardization Society Specification (MSS) SP-58.
- B. Pipe hangers shall be capable of supporting piping in all conditions of operation. They shall allow free expansion and contraction of piping, and prevent excessive stress resulting from transferred weight being induced into pipe or connected equipment. Support horizontal or vertical pipes at locations of least vertical movement.
- C. Where horizontal piping movements are such that hanger rod angularity from vertical is greater than 4 degrees from cold to hot position of pipe, offset hanger, pipe, and structural attachments so that rod is vertical in hot position.
- D. Hangers shall not become disengaged by movements of supported pipe.
- E. Provide sufficient hangers to adequately support piping system at specified spacing, at changes in piping direction and at concentrated loads. Hangers shall provide for vertical adjustment to maintain pitch required for proper drainage, and for longitudinal travel due to expansion and contraction of piping. Fasten hangers to building structural members wherever practicable.
- F. Unless indicated otherwise on drawings support horizontal steel piping as follows:

PIPE SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1-1/4"	3/8"	8 Ft.
1-1/2" to 2"	3/8"	10 Ft.
2-1/2" to 3-1/2"	1/2"	12 Ft.
4" and 5"	5/8"	15 Ft.

- G. Unless indicated otherwise on drawings support horizontal copper tubing as follows:

NOM. TUBING SIZE	ROD DIAMETER	MAXIMUM SPACING
Up to 1"	3/8"	6 Ft.
1-1/4" to 1-1/2"	3/8"	8 Ft.
2"	3/8"	9 Ft.
2-1/2"	1/2"	9 Ft.
3" and 4"	1/2"	10 Ft.

- H. Support horizontal cast iron soil pipe with two hangers for each section located close to each hub.
- I. Support vertical cast iron soil pipe at every floor, steel and copper tubing at every other floor except where indicated otherwise on drawings.
- J. Provide continuous threaded hanger rods wherever possible. No chain, wire, or perforated straps shall be

used.

- K. Hanger rods shall be subject to tensile loading only, where lateral or axial pipe movement occurs provide suitable linkage to permit swing. Provide pipe support channels with galvanized finish for concealed locations and painted finish for exposed locations. Submit design for multiple pipe supports indicating pipe sizes, service and support detail to Architect-Engineer for review prior to fabrication.
- L. Provide Grinnell pipe hangers for vertical pipe risers as follows:

PIPE MATERIAL	PIPE SIZE	HANGER FIG. NO.
Copper	½" thru 4"	CT-121
Steel	¾" thru 20"	261

- M. Provide Grinnell Fig. 194, 195 or 199 steel wall brackets for piping suspended or supported from walls. Brackets shall be prime coated carbon steel.
- N. Mount hangers for insulated piping on outside of pipe insulation sized to allow for full thickness of pipe insulation.
- O. Provide Grinnell Fig. 167 insulation protection shields sized so that line compressive load does not exceed one-third of insulation compressive strength. Shield shall be galvanized steel and support lower 180 degrees of pipe insulation on copper tubing. Provide calcium silicate blocking insulation at each pipe hanger in thickness of other adjacent insulation. Insulation vapor barrier jacket shall overlap to maintain vapor barrier continuous.

#### 3.4. INSULATION MATERIALS AND APPLICATIONS METHODS (HANGERS, SUPPORTS, ANCHORS, GUIDES, EXPANSION JOINTS, ETC.)

- A. Insulation materials and application methods for piping hangers supports, anchors, guides expansion joints, etc., shall be as follows:
  - 1. Insulate hangers and supports from direct contact with cold or hot surfaces (-120°F to 450°F) with rigid calcium silicate insulation at suspension points to prevent crushing of insulation.
  - 2. The length or thickness of the insulation support same as the pipe insulation thickness. Provide ASJ type discs or otherwise reestablish vapor barrier.
- B. Structural attachments for pipe hangers shall be as follows:
- C. Concrete Structure: Provide Grinnell Fig. No. 285 cast in concrete insert for loads up to 400 lbs. and Grinnell Fig. 281 wedge cast in type concrete insert for loads up to 1200 lbs.
- D. Provide Grinnell pipe hangers for horizontal single pipe runs as follows:

PIPE MATERIALS	PIPE SIZE	HANGER FIG. NO.
Copper	½" thru 4"	CT-65
Steel	3/8" thru 4"	65
Steel	5" thru 30"	260

- E. Provide Fee and Mason Fig. 600 channel trapeze pipe hangers for horizontal multiple pipe runs with pipe clamps or pipe rollers as follows:

PIPE MATERIALS	PIPE SIZE	CLAMP NO.	ROLLER NO.
Copper	3/8" thru 4"	8600 CP*	8010 CP*
Steel	3/8" thru 6"	8500	8010

\*Copper Plated

- F. Pipe supports for horizontal piping mounted on pipe racks or stanchions shall be Advanced Thermal Systems low friction graphite slide supports or equivalent by Elcen or Grinnell. Where racks and supports are not detailed on drawings submit detailed support drawings to Architect-Engineer for review prior to fabrication.
- G. Provide Fee and Mason Fig. 404 vibration control hangers at locations where piping vibrations would be transmitted to building structure by conventional hangers. Apply hangers within their load supporting range.
- H. Provide Elcen Fig. 50 pipe saddle with adjuster to support piping from floor. Provide complete with pedestal type floor stand.
- I. Provide necessary structural steel and attachment accessories for installations of pipe hangers and supports. Where heavy piping loads are to be attached to building structure verify structural loading with Architect-Engineer prior to installations.
- J. Equivalent hangers and supports by Auto-Grip, Basic Engineer, Bee Line, Elcen, Fee & Mason, Fluorocarbon Company, Unistrut or Super Strut Inc.

- K. Provide premanufactured pipe support for piping located on flat roofs, unless otherwise indicated on drawings. Support will be of modular designs with roller bearings and guide saddles for straight piping runs longer than 50' and Unistrut type clamp/support type for other shorter runs. Maximum pipe support spacing shall be 10' for steel piping. Copper piping and refrigerant piping shall be supported at shorter distances. Piping near equipment connections shall be supported within 3' of units. System supports shall be compatible with roofing materials and shall be provided with plates, pads, etc to spread weight and wear on roof surface. Provide pipe supports from Miro Industries, B-Line, or approved equivalent.

**END OF SECTION 221000**

## SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:

- 1. Unions
- 2. Strainers
- 3. Temperature-Actuated Mixing Valves
- 4. Hose Bibbs
- 5. Wall Hydrants
- 6. Trap Primer Valves
- 7. Backflow Preventers
- 8. Domestic Hot Water Expansion Tanks
- 9. Water Pressure Reducing Valves
- 10. Water Hammer Arrestors
- 11. Thermometers and Gauges.

#### 1.3. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

#### 1.4. QUALITY ASSURANCE

- A. 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. INSULATING UNIONS AND FLANGES

- A. Provide insulating unions and flanges conforming to following specifications and plainly and permanently marked with manufacturers name and pressure class rating. Unions and flanges shall be as follows:
  - 1. Steel pipe to steel pipe screwed end:
    - a. Provide Stockham malleable iron No. 693-1/2 insulating union with high dielectric strength insulating sleeve and gasket.
  - 2. Steel pipe to steel pipe flanged end:
    - a. Provide two weld neck flanges of proper pressure rating insulated on both sides with Central or Klingerit Flange Insulation Kit.
  - 3. Iron or steel pipe to copper pipe:
    - a. Provide Epco Dielectric union or flange with screwed or solder joint as required. Union shall have 250 PSI rating and flange 175 PSI rating at 190 degrees F.
    - b. Dielectric Waterway Fitting: Copper-silicon casting conforming to UNS C87850, and UL classified in accordance with ANSI / NSF-61 for potable water service, with threaded or grooved ends. Victaulic Style 647 or equal.

#### 2.2. UNIONS

- A. Provide unions or flanged joint in each line preceding connections to equipment or valves requiring maintenance.
  - 1. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.

- B. Provide Stockham brass seat unions of material and pressure rating required by piping system.
- C. Where piping systems of dissimilar materials are jointed together provide proper insulating union as specified under this specification.
- D. Equivalent unions by Fairbanks or Grinnell.

### 2.3. STRAINERS FOR DOMESTIC WATER PIPING

#### A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
- 5. If retaining more than one screen size, indicate screen size on Drawings.
- 6. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.062 inch
  - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
  - c. Strainers NPS 5 and Larger: 0.125 inch.
- 7. Drain: Factory-installed, hose-end drain valve.

- B. Install strainers upstream from automatic control valves, water service backflow preventers and RPZ backflow preventers 1" and larger. Where strainers are an integral part of these items or incorporated in accessory equipment directly upstream, individual line strainers will not be required. Strainers shall be same size as piping. Provide strainers with proper isolation and blow down valves to allow basket removal for cleaning.
- C. Install strainer so that basket contains debris by gravity at no flow conditions to allow removal of large debris not able to be passed by blow down.

### 2.4. TEMPERATURE-ACTUATED WATER MIXING VALVES

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
  - a. Acorn Engineering Co.
  - b. Armstrong International, Inc.
  - c. Lawler Manufacturing Company, Inc.
  - d. Leonard Valve Company.
  - e. Powers; a Watts Industries Co.
  - f. Symmons Industries, Inc.
  - g. Standard: ASSE 1017.
- 2. Pressure Rating: 125 psig.
- 3. Type: Cabinet-type, thermostatically controlled water mixing valve.
- 4. Material: Bronze body with corrosion-resistant interior components.
- 5. Connections: Threaded union inlets and outlet.
- 6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
- 7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
- 8. Valve Finish: Rough bronze.
- 9. Piping Finish: Copper.
- 10. Cabinet: Factory-fabricated, stainless steel, for recessed applications in finished spaces and surface mounting in plumbing spaces and with hinged, stainless-steel door.

### 2.5. HOSE BIBBS

- 1. Standard: ASME A112.18.1 for sediment faucets.
- 2. Body Material: Bronze.
- 3. Seat: Bronze, replaceable.
- 4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
- 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
- 6. Pressure Rating: 125 psig.
- 7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
- 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
- 9. Finish for Service Areas: Rough bronze.
- 10. Finish for Finished Rooms: Chrome or nickel plated.

11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation: Wheel handle.
13. Include operating key with each operating-key hose bibb.
14. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.6. WALL HYDRANTS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. Prier Products, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Woodford Manufacturing Company.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with locking cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

## 2.7. TRAP-SEAL PRIMER VALVES

### A. Supply-Type, Trap-Seal Primer Valves :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. PPP Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts Industries, Inc.; Water Products Div.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## 2.8. BACKFLOW PREVENTERS

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

1. All types of backflow preventers listed:
  - a. Watts
  - b. Febco
  - c. Zurn-Wilkins
2. Vacuum breakers, single check valves:
  - a. Cash Acme

### B. Provide where shown on plans the following types of backflow preventers. Provide isolation valve ahead of backflow preventers.

1. Reduced Pressure Zone Principle (1/4"-1/2"):
  - a. Watts Series 009 reduced pressure backflow preventer complete with strainers and valves.
2. Reduced Pressure Zone Principle (3/4"-10"):

- a. Watts Series 909 reduced pressure backflow preventer complete with strainers and valves. Provide isolation valve ahead of backflow preventers. Provide with air gap fitting and pipe to floor drain.
3. Double Check Valve (1/2"-2"):
  - a. Watts Series 007 double check valve assembly complete with ball type test cocks, full port ball valve shut offs and strainer.
4. Double Check Valve (2-1/2"-10"):
  - a. Watts Series 709 double check valve assembly complete with ball type test cocks, OS&Y valve shut offs and strainer. Epoxy coated cast iron check valve bodies with bronze seats.
5. Pressure Vacuum Breakers (1/2"-2"):
  - a. Watts Series 800M4QT pressure vacuum breaker with integral ball valve shut offs.
6. Pressure Vacuum Breakers (3/8"-1/2"):
  - a. Watts Series 008QT pressure vacuum breaker for anti-spill applications, with integral ball valve shut offs.
7. Atmospheric Vacuum Breaker (1/4"-3"):
  - a. Watts Series 288A atmospheric vacuum breaker in plain brass finish.
8. Hose Bibb Vacuum Breakers
  - a. Vacuum Breakers for hose end connections shall be Watts Series 8 non removable type.

#### 2.9. DOMESTIC HOT WATER EXPANSION TANKS

- A. The expansion tank shall be welded steel, diaphragm type tank, and pre-charged to the minimum operating pressure. Tanks shall be suitable for domestic water service.
- B. Provide expansion tanks as shown on plans by Amtrol, Bell and Gossett, Watts.

#### 2.10. WATER PRESSURE-REDUCING VALVES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cash Acme.
  2. Conbraco Industries, Inc.
  3. Honeywell Water Controls.
  4. Victaulic Company.
  5. Watts Industries, Inc.; Water Products Div.
  6. Zurn Plumbing Products Group; Wilkins Div.
- B. Standard: ASSE 1003.
- C. Pressure Rating: Initial working pressure of 150 psig.
- D. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
  1. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

#### 2.11. WATER HAMMER ARRESTERS:

- A. ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F. Manufacturers: Amtrol, Josam, Sioux Chief, Watts, Zurn.
- B. Provide water hammer arrestors for all plumbing banks with fixtures utilizing flush valves in any capacity. Locate arrester between the last two fixtures served on the branch line. Water Closet = 10FU, Urinals = 5FU, Lavatories = 1.5FU.

FIXTURE UNITS (FU)	UNIT SIZE
1-11	A
12-32	B
33-60	C
61-113	D
114-154	E

155-330	F
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- C. When no flush valves are installed on a branch of piping provide ¾"x12" air chambers at each hot and cold water supply connection to a plumbing fixture. Contractor may provide water hammer arresters above the ceiling before dropping into masonry construction in lieu of air chambers. Connections to other items such as washers, ice makers, or other equipment shall be provided with an appropriately sized water hammer arrester for each water connection.

## 2.12. THERMOMETERS AND GAUGES

### A. GENERAL

1. Provide thermometers and wells and pressure test plugs as hereinafter specified and shown on the plans so that proper testing and balancing and trouble shooting can be accomplished.

### B. THERMOMETERS

1. Thermometers shall be red reading mercury type having scale length of not less than 9", and scale divisions of 2 degrees F, or less similar and approved equal to Moeller Instrument Company, Inc., Style AJ. Range shall be as specified or as required for the duty. Thermometers and wells must be of at least the quality and design specified. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Moeller, Terrice or Weksler.
2. Install thermometers at eye level (5'-0") at easily readable locations.

### C. GAUGES

1. Gauges shall be bourdon tube with minimum 4-1/2" dial and die cast aluminum case with black enamel finish. The movement shall be all stainless steel with Grade A phosphor bronze bourdon tube brazed at socket and tip. The accuracy of the gauge shall be within ½ percent of the scale range. The pointer shall be the micrometer adjustment type recalibrated from the front. Pressure, compound, and differential pressure gauges shall have suitable scale ranges, shall be submitted and are subject to the review of the Engineer. Graduations shall be one pound or less on all gauges where this is standard for the required range.
2. Gauges shall have ¼" IPS connections and shall be Moeller "Vantage" gauges with Case Style No. 2, or approved equal. If it complies with these specifications, equipment manufactured by one of the following manufacturers will be acceptable: Ashcroft, Marsh, Terrice, Moeller, Weksler, Taylor, Weiss, or Midwest.
3. Install a Sisco ¼" or ½" NPT fitting (Test Plug) of solid brass at desired indicated locations. Test plug shall be capable of receiving either a pressure or temperature probe 1/8" o.d. Dual seal core shall be neoprene for temperature to 200°F and shall be rated zero leakage from vacuum to 1000 psig.
4. Install gauges vertically.

### D. INSTALLATION

1. Thermometers shall be installed as hereinafter specified. Where thermometer is scheduled, a thermometer well shall be provided.
2. All thermometer wells shall be constructed of brass or stainless steel and where installed in insulated piping shall have at least 2-1/2" lagging extension. Gauges shall be installed as hereinafter specified.
3. Gauge cocks shall be polished brass A10 ¼" tee handle type with threaded ends. 125 psi rated.
4. Provide gauge cock with ¼" pipe nipple for connection to gauge cock.
5. Pressure temperature ratings of each well shall be suitable for the system in which it is installed in accordance with specifications and as indicated on the drawings. All wells shall be filled with Silicon and be complete with caps and chains.
6. Thermometers shall have the temperature ranges as required for the intended application and shall be installed as scheduled.

### E. THERMOMETER & TEST GAUGE COCK INSTALLATION SCHEDULE

SERVICE	Thermometer & Well	Press Gauge & Gauge Cock
Hot water entering and leaving heaters	X	
Hot water entering and leaving storage tanks	X	
Water Service ahead of PRV		X
Water Service after PRV	X	X
Fire Water Service		X

### PART 3 EXECUTION

#### 3.1. INSTALLATION

- A. Refer to other Division 22 Sections for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to plumbing 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 balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet. Install at approximately 6' AFF for service and maintenance.
  - 1. Install thermometers and water regulators if specified.
  - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Install water hammer arresters in water piping according to PDI-WH 201.
- H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- J. 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."

#### 3.2. FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each 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.

#### 3.3. ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
- D. Prior to occupancy the contractor shall balance all components of the recirculation system to insure hot water is delivered throughout the building. This shall be done at times of low usage of the domestic system to insure systems functions during times of low/no use. Mark all valves, record settings of balance and provide documentation to owner at turnover.

**END OF SECTION 221119**

## SECTION 221319 – SANITARY WASTE 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 sanitary drainage piping specialties:

- 1. Cleanouts.
- 2. Floor drains.
- 3. Miscellaneous sanitary drainage piping specialties.
- 4. Roof flashing assemblies.

#### 1.3. SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

- 1. Cleanouts.
- 2. Drains (floor, roof, trench, etc.).

#### 1.4. 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.

### PART 2 PRODUCTS

#### 2.1. CLEANOUTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated below or a comparable product by one of the following:
  - 1. Josam Company; Josam Div.
  - 2. Sioux Chief Manufacturing Company, Inc.
  - 3. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - 4. Tyler Pipe; Wade Div.
  - 5. Watts Drainage Products Inc.
  - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Floor (Concrete Floor Finish):
  - 1. Wade #W-6000-XS cast iron cleanout with square, heavy duty, scoriated nickel bronze top, adjustable above to finished floor.
- C. Floor (Quarry Tile Floor Finish):
  - 1. Same as concrete floor finish.
- D. Floor (Tile Floor Finish):
  - 1. Wade #W-6000-TS cast iron cleanout with square heavy duty nickel bronze top, recessed for tile and adjustable to finished floor.
- E. Wall:
  - 1. Wade #W-8450-C cleanout with dura-coated cast iron ferrule and cadmium plated cast iron counter-sunk plug complete with round smooth nickel bronze wall access cover and flush over-wall frame.
- F. Verify floor materials used from Architectural plans and provide proper cleanout tops, where they occur in carpet, quarry tile, vinyl tile or ceramic tile.

#### 2.2. FLOOR DRAINS

- A. Cast-Iron Floor Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group.
2. Standard: ASME A112.6.3.
3. Body Material: Gray iron.
4. Seepage Flange: Required for all elevated slabs.
5. Anchor Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Top or Strainer Material: Nickel bronze in public spaces or rough bronze in mechanical spaces unless otherwise scheduled.
9. Top of Body and Strainer Finish:
10. Top Shape: Square in tiled areas. All others shall be round.
11. Dimensions of Top or Strainer: As scheduled.
12. Trap Material: Cast iron.
13. Trap Pattern: Deep-seal P-trap.
14. Trap Features: Trap-seal primer valve drain connection where shown on plans.

### 2.3. MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

#### A. Open Drains

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

#### B. 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.

### 2.4. 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. 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.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 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 backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with

- floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4 (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.
  5. Not all required cleanouts are shown on the plans in the interest of drawing clarity. Cleanout that are shown are shown are to be located as shown. Additional code required cleanouts shall be located to be along walls (not in middle of halls or large floor areas) and out of general sight lines where possible. Install cleanouts so they are accessible by extending them through walls, and floors, to outside of building, or to above grade as required.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
  2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches (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.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- J. Install deep-seal traps on floor drains and other waste outlets..
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  2. Size: Same as floor drain inlet.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- P. Install wood-blocking reinforcement for wall-mounting-type specialties.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- R. 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.

### 3.2. CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3. 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.

### 3.4. 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 223300 – ELECTRIC WATER HEATERS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. ELECTRICAL WORK REQUIRED

- A. Contractor shall provide electrical connections for any equipment that requires electrical connections for power or control. Electrical requirements and work shall be coordinated with Electrical Contractor.

#### 1.3. SUBMITTALS

- A. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Shop Drawings: Detail water heater 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 systems. Differentiate between manufacturer-installed and field-installed wiring.
- C. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
- D. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.
- E. Warranties: Special warranties specified in this Section.

#### 1.4. QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.
- D. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
  - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.
  - 2. ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings," for household water heaters.

#### 1.5. WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.
- C. Warranty Period: From date of Substantial Completion:
  - 1. Storage Tanks: 5 years.

### PART 2 - PRODUCTS

#### A. POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS 30 GALLONS AND LESS

- 1. Provide water heaters as scheduled by State, Rheem, Eemax, A.O. Smith, Bosch, Lochinvar. Refer to schedule for capacities and characteristics.
- 2. Storage Tank Construction: Steel with 150-psig working-pressure rating.
- 3. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
- 4. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
- 5. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
- 6. Jacket: Steel, with enameled finish.
- 7. Heating Elements: electric, screw-in, immersion type.
- 8. Temperature Control: Adjustable thermostat for each element.

9. Anode Rod: Factory installed, magnesium.
10. Drain Valve: ASSE 1005, factory installed.
11. Electrical characteristics as scheduled. Coordinate with electrician for wiring requirements.
12. Provide with 3 year warranty.
13. Where unit is suspended provide adequate supports and shelf. Mount above ceiling where ceiling is accessible. Mount all components for heater where suspended or wall mounted no lower than 6'-8" above finished floor.
14. Where unit is located in cabinetry or under sinks, take care to coordinate with other trades and piping to provide all adequate clearances and serviceability.

**B. COMMERCIAL, POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS LARGER THAN 30 GALLONS**

1. Provide water heaters as scheduled by State, Rheem, A.O. Smith, PVI, Lochinvar. Refer to schedule for capacities and characteristics.
2. Description: Comply with UL 174 or UL 1453, and listed by manufacturer for commercial applications.
3. Storage Tank Construction: Non-ASME-code steel with 150-psig working-pressure rating.
  - a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
  - b. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
  - c. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
  - d. Jacket: Steel, with enameled finish.
4. Heating Elements: Two, unless otherwise indicated; electric, screw-in, immersion type.
  - a. Temperature Control: Adjustable thermostat.
5. Anode Rod: Factory installed, magnesium.
6. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
7. Special Requirement: NSF 5 construction.
8. Provide water heaters as scheduled by State, Rheem, National, or A.O. Smith. Refer to schedule for capacities and characteristics.
9. Units shall have a porcelainized glasslined tank, protected in the following ways:
  - a. Against failure due to overheating caused by the buildup of scale, film and other sediment by a cold water inlet tube, which is an integral part of the heater, that churns and agitates particles of sand, silt or scale present in the water, so they are carried out of the water heater on successive hot water draws.
  - b. Against electrolytic corrosion by conveniently located, easily replaceable magnesium anode rods.
10. Water heaters shall have the U.L. seal of certification, a working pressure rating of 160 psi, a factory installed Temperature and Pressure Relief Valve, and a full-size (4"x5") inspection port. Water heater shall also be equipped with N.S.F. construction.
11. Water heater tanks shall be covered by a 3 year limited warranty against failure due to metal fatigue and overheating caused by buildup of sand, sediment or sludge.

**PART 3 - EXECUTION**

**3.1. WATER HEATER INSTALLATION**

- A. Install commercial water heaters on concrete bases.
  1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Anchor water heaters to substrate.
- D. Install seismic restraints for water heaters where located in seismic zones. Anchor to substrate.
- E. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- F. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

- G. Install vacuum relief valves in cold-water-inlet piping.
- H. Install vacuum relief valves in water heater storage tanks that have copper lining.
- I. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Plumbing Specialties" for drain valves.
- J. Install thermometers on water heater inlet and outlet piping. Refer to Division 22 Section "Meters and Gages" for thermometers.
  - 1. Exception: Omit thermometers for water heaters 30 gallons and less.
- K. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 15 Section "Valves" for general-duty valves and Division 22 Section "Meters and Gages" for thermometers.
- L. Arrange for insulation on equipment and piping not furnished with factory-applied insulation.
- M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- N. Fill water heaters with water.
- O. Charge compression tanks with air.

### 3.2. ELEVATED TANKS

- A. Elevated tanks shall be securely supported from structure and provided with drain pan.
- B. Pipe drain pan to nearest floor drain or mop sink.
- C. Install tank and support assembly at a minimum of 6'-6" above finished floor level. Install higher if structure allows, but no higher than 10' above finish floor unless specifically indicated.

### 3.3. 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 machine to allow service and maintenance.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- D. Make connections with dielectric fittings where piping is made of dissimilar metal.
- E. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service.
- F. Ground equipment.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4. FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to perform startup service.
- B. In addition to manufacturer's written installation and startup checks, perform the following:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
  - 2. Verify that piping system tests are complete.
  - 3. Check for piping connection leaks.
  - 4. Check for clear relief valve inlets, outlets, and drain piping.
  - 5. Check operation of circulators.
  - 6. Test operation of safety controls, relief valves, and devices.
  - 7. Energize electric circuits.
  - 8. Adjust operating controls.
  - 9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.
  - 10. Balance water flow through manifolds of multiple-unit installations.

### 3.5. DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
  - 1. Train Owner's maintenance personnel on procedures for starting and stopping troubleshooting, servicing, and maintaining equipment.
  - 2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**END OF SECTION 223300**

## SECTION 224000 – PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: As applicable, provide dimensional data and diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify components properly fit in construction, cabinetry, chases, etc.

#### 1.3. ELECTRICAL WORK REQUIRED

- A. Contractor shall provide electrical connections for any equipment that requires electrical connections for power or control. Electrical requirements and work shall be coordinated with Electrical Contractor.

#### 1.4. PIPING SYSTEMS

- A. Refer to Section 221116 of this specification for piping material specifications and installation instructions. Specific piping materials and joining methods for systems installed under this section shall be as listed in schedule.

#### 1.5. PIPING SYSTEMS VALVES

- A. Refer to Section 22 "Valves" of this specification for valve type specifications and installation instructions.

#### 1.6. PIPING SYSTEMS INSULATION

- A. Refer to Section 22 "Insulation" insulation type specifications and installation instructions.

### PART 2 - PRODUCTS

#### 2.1. MANUFACTURERS

- A. Equivalent fixtures and accessories by following manufacturers will be acceptable.
  - 1. Fixtures: American Standard, Kohler, Crane, Zurn, Toto.
  - 2. Institutional/Correctional: Bradley, or Acorn
  - 3. Stainless Steel Fixtures: Elkay, Just, Moen Commercial
  - 4. Fittings and Supports: Josam, Smith, Wade, Zurn, or Jonespec.
  - 5. Seats: Church, Olsonite, Bemis or Beneke.
  - 6. Drinking Fountains: Halsey Taylor, Elkay, Oasis, or Haws.
  - 7. Lavatory & Sink Trim: Eljer, Chicago, Bradley, Sloan, Moen Commercial or American Standard.
  - 8. Traps, Supplies and Stops: Dearborn, Brass Craft, Central D, Sanitary Dash or as specified under plumbing fixtures.
    - a. Supplies and Stops: Dearborn Fig. No. 2700 CW 1/2" compression loose key stop and 3/8" O.D. risers in length required. Provide deep chrome plated brass escutcheons.
    - b. Traps: Dearborn #FS510 (1-1/2") and/or EFS507 (1-1/4") cast brass body with clean-out and 17 gauge tube outlet "P" trap. Provide deep chrome plated brass escutcheon with set screw.

#### 2.2. PLUMBING FIXTURES

- A. Provide plumbing fixtures as shown on drawings and as specified complete including piping and connections. China fixtures shall be of best grade vitreous ware without pit holes or blemishes and outlines shall be generally true. Architect-Engineer reserves right to reject any piece, which in their opinion is faulty. Fixtures fitting against walls shall have ground backs. Exposed piping and fittings shall be chrome plated.
- B. All wall mounted urinals and lavatories shall be furnished with concealed arm carriers. All wall-mounted water closets shall be furnished with concealed carriers.
- C. Set fixtures true and level with all necessary supports for fixtures installed before wall finish is done. Nipples through wall to fixture connections shall be chrome plated brass. Provide silicone sealer around perimeter of lavatories, water closets, and urinals at connection to wall and/or floor.

### 2.3. LAVATORY FAUCETS:

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. American Standard Companies, Inc.
  2. Bradley Corporation.
  3. Chicago Faucets.
  4. Delta Faucet Company.
  5. Eljer.
  6. Kohler Co.
  7. Moen Commercial
  8. Zurn Plumbing Products Group; Commercial Brass Operation.
- B. Description: Single-control mixing, Single-control nonmixing, and Two-handle mixing as scheduled valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
1. Body Material: Commercial, solid brass
  2. Finish: As Scheduled.
  3. Maximum Flow Rate: 0.5 gpm (1.5 L/min.) for public lavatories. Private lavatories shall be a maximum of 2.2 gpm (8.3 L/min.)
  4. Centers: As scheduled and coordinated with fixtures.
  5. Valve Handle(s): ADA Compliant wrist blade, 4 inches (102 mm) unless otherwise scheduled.
  6. Spout: Rigid in public locations. Coordinate gooseneck swing or rigid installation with architect prior to installation.
  7. Spout Outlet: As scheduled.
  8. Tempering Device: Provide thermostatic tempering device piped in supply for all public lavatories unless tempering is otherwise provided.
  9. Where electronic fixtures are specified, provide will all transformers, cables, junction boxes, sensors and controls. All equipment and installation shall have neat and orderly appearance.

### 2.4. FLUSHOMETERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
1. Sloan.
  2. Zurn.
  3. Toto.
- B. Description: Flushometers for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
1. Internal Design: Diaphragm or piston operation as scheduled.
  2. Style: Exposed or Concealed as scheduled.
  3. Consumption: Low flow type coordinated with flow requirements of fixture served.
  4. Tailpiece Size: Coordinated with spud of fixture and length as required for valve location to properly mounted fixture elevation.
- C. Provide recessed vandal proof covers and boxes for all recessed/concealed style flush valves.
- D. Provide all required junction boxes, power supplies and wiring for line voltage style flush valves when scheduled.
- E. All exposed components shall be chrome finished or brushed nickel or similar durable finish.

### 2.5. PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Engineered Brass Co.
    - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
    - c. McGuire Manufacturing Co., Inc.
    - d. Plumberex Specialty Products Inc.
    - e. TCI Products.
    - f. TRUEBRO, Inc.
    - g. 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.

### PART 3 EXECUTION

#### 3.1. GENERAL

- A. All plumbing fixtures shall be cleaned and free of all construction debris.
- B. Electric water cooler shall be protected during construction.
- C. Any chrome trim with wrench marks shall be removed and new trim installed.
- D. Architect-Engineer reserves the right to reject any plumbing fixture.
- E. See plans for Plumbing Fixture Schedule.

#### 3.2. 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 floor mounted water closets and other fixtures with solid waste using only 45 degree and combination fittings. Do not use sanitary tees in horizontal applications.
- F. Install wall-mounting fixtures with tubular waste piping attached to supports.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- M. Install toilet seats on water closets.
- N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- R. Install traps on fixture outlets.
  1. Exception: Omit trap on fixtures with integral traps.
  2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- S. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- T. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck where sink is stainless steel type or on countertop at sink where sink is integral or there is no deck for sink. Connect inlet hose to dishwasher and outlet hose to disposer.
- U. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.
- V. 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 "Basic Plumbing Materials and Methods."
- W. Set bathtubs and showers in leveling bed of cement grout.
- X. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

#### 3.3. CONNECTIONS

- A. Piping installation requirements are specified in other 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."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

#### 3.4. 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.

#### 3.5. PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION 224000**

PKMR Engineers, LLC  
PKMR #22.113

Platte County, MO  
Platte Ridge Park

END OF DIVISION 220000

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## SECTION 230010 – MECHANICAL PROVISIONS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Mechanical Contractor, all sub-contractors, and all material suppliers.

#### 1.2. SCOPE OF WORK

- A. This DIVISION requires the furnishing and installing of complete functioning Mechanical systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. In case of an inconsistency between the Drawings and Specifications or within either document, the better quality or the greater quantity of work shall be provided in accordance with the Architect or Engineer's interpretation.
- C. Refer to Architectural, Structural and Electrical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing piping and ductwork in the manner anticipated in the design.

#### 1.3. SPECIFICATION FORM AND DEFINITIONS

- A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, EMAIL admin@pkmreng.com.
- B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.
- C. When a word, such as "proper", "satisfactory", "equivalent", and "as directed", is used, it requires the Architect-Engineer's review.
- D. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
- E. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
- F. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
- G. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
- H. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.
- I. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.
- J. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

#### 1.4. QUALIFICATIONS

- A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

#### 1.5. LOCAL CONDITIONS

- A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

#### 1.6. CONTRACT CHANGES

- A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.

#### 1.7. LOCATIONS AND INTERFERENCES

- A. Locations of equipment, piping and other mechanical work are indicated diagrammatically by the mechanical drawings. The Contractor shall determine the exact locations on site, subject to structural conditions, work of other Contractors, and access requirements for installation and maintenance to approval of Architect-Engineer. Provide additional piping and ductwork offsets as required at no additional cost.
- B. Study and become familiar with the contract drawings of other trades and in particular the general construction plans and details in order to obtain necessary information for figuring installation. Cooperate with other contractors and install work in such a way as to avoid interference with their work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.
- C. Any pipe, ductwork, equipment, apparatus, appliance or other item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other work caused by this Contractor, the Subcontractor, or workers shall be restored as specified for new work.
- D. Do not scale mechanical and electrical drawings for dimensions. Contractor shall accurately layout work from the dimensions indicated on the Architectural drawings unless they are found to be in error.

#### 1.8. PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.
- B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

#### 1.9. WARRANTY

- A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
- B. Warranty for all equipment shall take effect from the date of substantial completion regardless of the date equipment was installed.
- C. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

#### 1.10. ALTERNATES

- A. Refer to General Requirements for descriptions of any alternates that may be included.

#### 1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

- A. The intent of these specifications is to allow ample opportunity for Contractor to use his ingenuity and abilities to perform the work to his and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
- C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
- D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.
- E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.
- F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.

- G. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in mechanical or electrical service requirements necessary to accommodate such substitution.
- H. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

**1.12. ELECTRONIC PLAN FILES**

- A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of \$50 per sheet, \$100 minimum and \$25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

**1.13. TEMPORARY USE OF PERMANENT HVAC UNITS**

- A. If the Contractor elects to use permanent equipment for temporary conditioning only that permanent equipment associated with the heating system shall be allowed for use as space conditioning during the construction period. The Mechanical Contractor shall take full responsibility for all permanent equipment used for temporary conditioning during the construction period and shall provide a total of two years warranty covering all parts and labor on all permanent equipment utilized for temporary conditioning. This warranty shall cover all piping, fittings, valves, pipe and equipment insulation, pumps, boilers, chillers, condensing units, cooling towers, air handling units, exhaust and relief air fans, ductwork, ductwork insulation, diffusers, temperature controls, all electric motors, starters, disconnect switches, fuses, wire and conduit. This warranty shall cover all required maintenance on the system with the exception of filter changes, and shall start on the date shown on the final completion certificate.
- B. CAUTION: The Contractor is being warned that the Architect-Engineer will not accept dirty equipment caused by construction contamination.

**1.14. OPENINGS, ACCESS PANELS AND SLEEVES**

- A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all pipes passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.
- B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

**1.15. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS**

- A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

**1.16. EXTENT OF CONTRACT WORK**

- A. Provide mechanical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of mechanical systems. In no case will claims for "Extra Work" be allowed for work about which Contractor could have been informed before bids were taken.
- B. Electrical work required to install and control mechanical equipment, which is not shown on plans or specified under Division 26, shall be included in Contractor's base bid proposal. Mechanical systems and components are to be installed as a complete system, including all miscellaneous interlock (low voltage and minor line voltage power wiring such as control motors, limit switches, relays, etc), control wiring, safeties. Coordinate interlock to other systems such as fire alarm that interlock to mechanical systems and insure that provisions are made in equipment for connection of these systems. Coordinate with all other trades for specific needs and requirements based on submitted systems.
- C. Contractor shall become familiar with equipment provided by other contractors that require mechanical connections and controls.
- D. All automatic temperature control devices shall be mounted as indicated in automatic temperature control section of specifications.
- E. The cost of larger wiring, conduit, control and protective devices resulting from installation of equipment which

was not used for basis of design as outlined in specifications shall be paid for by Mechanical Contractor at no cost to Owner or Architect-Engineer.

- F. Contractor shall be responsible for providing supervision to Electrical Contractor to insure that required connections, interlocking and interconnection of mechanical and electrical equipment are made to attain intended control sequences and system operation.
- G. Furnish four complete sets of electrical wiring diagrams to Architect-Engineer to be included in the maintenance manuals and three complete sets to Electrical Contractor. Diagrams shall show factory and field wiring of components and controls. Control devices and field wiring to be provided by Electrical Contractor shall be clearly indicated by notation and drawing symbols on wiring diagrams.
- H. Contractor shall obtain complete electrical data on mechanical shop drawings and shall list this data on an approved form that shall be presented monthly or on request, to Electrical Contractor. Data shall be complete with wiring diagrams received to date and shall contain necessary data on electrical components of mechanical equipment such as HP, voltage, amperes, watts, locked rotor current to allow Electrical Contractor to order electrical equipment required in his contract.

#### 1.17. WORK NOT INCLUDED IN CONTRACT

- A. Consult Division 26 of specifications for work to be provided by Electrical Contractor in conjunction with installation of mechanical equipment.

#### 1.18. CODES, RULES AND REGULATIONS

- A. Provide Work in accordance with applicable codes, rules and regulations of Local and State, Federal Governments and other authorities having lawful jurisdiction.
- B. Conform to latest editions and supplements of following codes, standards or recommended practices.
- C. BUILDING CODES:
  - 1. International Codes (Latest adopted version of applicable codes)
- D. SAFETY CODES:
  - 1. National Electrical Safety Code Handbook H30 - National Bureau of Standards.
  - 2. Occupational Safety and Health Standard (OSHA) - Department of Labor.
- E. NATIONAL FIRE CODES:
  - 1. NFPA No. 54 National Fuel Gas Code
  - 2. NFPA No. 70 National Electrical Code
  - 3. NFPA No. 89M Clearances, Heat Producing Appliances
  - 4. NFPA No. 90A Air Conditioning and Ventilating Systems
  - 5. NFPA No. 91 Standard for Exhaust Systems
  - 6. NFPA No. 101 Life Safety Code
  - 7. NFPA No. 204 Standard for Smoke and Heat Venting
- F. UNDERWRITERS LABORATORIES INC:
  - 1. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.
- G. MISCELLANEOUS CODES:
  - 1. ANSI A117.1 - Handicapped Accessibility
  - 2. Applicable State Boiler Codes
  - 3. Americans with Disabilities Act (ADA)
- H. ENERGY EFFICIENCY REQUIREMENTS:
  - 1. All mechanical systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 – 2007 and latest adopted version of IECC.

#### 1.19. STANDARDS

- A. Drawings and specifications indicate minimum construction standard. Should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect-Engineer in writing before proceeding with work so that necessary changes can be made. However, if the Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations, Contractor shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

#### 1.20. PERMITS/FEES

- A. The Contractor shall secure and pay for necessary permits and certificates of inspection required by

governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect-Engineer with request for final inspection.

- B. The Contractor shall include in their base bid any fees or charges by the local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exactly which part of the work required for the new utility service, is to be performed by the contractor and which part will be supplied by the utility company.

## PART 2 - PRODUCTS

### 2.1. Not Used

## PART 3 - EXECUTION

### 3.1. SUBMITTALS

- A. Contractor shall furnish submittals of all materials and equipment required by the specifications. Refer to each specification section for the submittals (if any) required for that section.
- B. Submittal format shall be as indicated below. Submittals not meeting these requirements will be returned without action for re-submittal.
  - 1. Submittals shall be furnished in an Adobe PDF format.
  - 2. Submittals shall be per individual submittal section, as listed in the table of contents. All required submittals within that section shall be grouped together in a single submittal.
    - a. Furnishing submittals by division or by individual item may result in delayed reviewing of the submittal(s) due to additional administrative time required to process the large size and/or quantity of files.
  - 3. Submittals shall have a cover page containing the following information: The project name, the applicable specification section and paragraph, the submittal date, and the Contractor's stamp (see below for requirements).
  - 4. Mark each submitted item as applicable with scheduled mark, name, etc. corresponding to the plans.
  - 5. Where generic catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Each catalog sheet shall bear the equipment manufacturer's name and address.
  - 6. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization.
  - 7. All submittals on materials and equipment listed by UL shall indicate UL approval on submittal.
- C. Contractor review:
  - 1. Contractor shall check all submittals to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All submittals submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All submittals not meeting Contractor's approval shall be returned to their supplier for re-submittal.
  - 2. No submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.
  - 3. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- D. Review Schedule:
  - 1. The shop drawing / submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required.
  - 2. Submittal of all shop drawings as soon as possible after permitting approval but before construction starts is preferred.
  - 3. Approval of shop drawings submitted prior to receipt of a permit for that respective scope of work should be considered conditional pending review/approval of the construction documents by the AHJ. Changes required to the submittal as a result of permitting comments received after architect's/engineer's review shall not be a justification for a change in price.
  - 4. Any time delay caused by correcting and re-submitting submittals/shop drawings will be the

Contractor's responsibility.

- E. The Architect's-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.
- F. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.
- G. Submittals that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.
- H. Coordination
  - 1. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

**3.2. SHOP DRAWINGS**

- A. Shop drawings shall meet all of the above requirements for submittals.
- B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
- C. No work shall be fabricated until Architect-Engineer's review has been obtained.
- D. Sheet metal shop drawings for duct fabrication shall be a minimum of 1/4" scale. Sheet metal shop drawings shall not be a reproduction of the contract document and shall show details of the following: Fabrication, assembly, and installation, including plans, elevations above finished floor, sections, components, and attachments to other work. Duct layout indicating pressure classifications and sizes on plans, fittings, reinforcement and spacing, seam and joint construction, penetrations through fire-rated and other partitions, hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.

**3.3. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)**

- A. Submit with shop drawings of equipment, four copies of installation, operating, maintenance instructions, and parts lists for equipment provided. Equipment manufacturer shall prepare instructions.
- B. Keep in safe place, keys and wrenches furnished with the equipment provided under this contract. Present to the Owner and obtain a receipt for them upon completion of project.
- C. Prepare a complete brochure, covering systems and equipment provided and installed under this contract. Submit brochures to Architect-Engineer for review before delivery to Owner. Brochures shall contain following:
  - 1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined above.
  - 2. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
  - 3. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
  - 4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of mechanical system.
- D. Provide brochures bound in three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
  - 1. Project name and address.
  - 2. Section of work covered by brochure, i.e., "Plumbing", etc.

**3.4. RECORD DOCUMENTS**

- A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
- B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
- C. Provide one copy of on high quality heavy weight presentation type paper. Blueprints or other media which fade shall not be used.

- D. Provide one electronic scanned version of record documents in Adobe PDF format – PDFs may be submitted on electronic media (DVD, USB) or via an FTP or other file sharing site. Provide electronic copies in conjunction with hard copy documents.

### 3.5. CLEANING UP

- A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
- B. Contractor shall clean up all ductwork and equipment at the completion of the project.
- C. All equipment, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

### 3.6. WATERPROOFING

- A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
- B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

### 3.7. CUTTING AND PATCHING

- A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.
- B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
- C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of mechanical work shall be repaired at Contractor's expense to approval of Architect-Engineer.

### 3.8. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundation and provide proper anchor bolts and isolation as shown, specified or required by manufacturers in installation instructions. Level, shim and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instructions.
- B. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
- C. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
- D. Provide floor or slab mounted equipment with 3-1/2" high concrete bases unless specified otherwise. Mechanical contractor shall form all pads; General contractor shall provide and place all concrete and reinforcing for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
- E. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best-recognized practice. Verify that structural members of buildings are adequate to support equipment and unless otherwise indicated on plans or specified, arrange for their inclusion and attachment to building structure. Provide hangers with vibration isolators.
- F. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect-Engineer for review before proceeding with fabrication or installation.

### 3.9. START-UP, CHANGEOVER, TRAINING AND OPERATIONAL CHECK

- A. Contractor shall perform the initial start-up of the systems and equipment and shall provide necessary supervision and labor to make the first seasonal changeover of systems. Personnel qualified to start-up and service this equipment, including manufacturer's technicians, and the Owner's operating personnel shall be present during these operations.
- B. Contractor shall be responsible for training Owner's operating personnel to operate and maintain the systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructors name, names of Owner's personnel attending and total hours of instruction given each individual.
- C. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the

end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

3.10. FINAL CONSTRUCTION REVIEW

- A. At final construction review, each respective Contractor and major subcontractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by the Architect-Engineer, that the work complies with the purpose and intent of the contract documents. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

**END OF SECTION 230010**

## SECTION 230011 – BASIC MECHANICAL MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Provide documentation of all completed tests described herein and their results.

### PART 2 – PRODUCTS (NOT APPLICABLE)

### PART 3 - EXECUTION

#### 3.1. TESTING PROCEDURES FOR PIPING SYSTEMS

- A. Test all lines and systems before they are insulated, painted or concealed by construction or backfilling. Provide fuel, water, electricity, materials, labor and equipment required for tests.
- B. Where entire system cannot be tested before concealment, test system in sections. Verify that system components are rated for maximum test pressures to be applied. Where specified test pressures exceed component ratings, remove or isolate components from system during tests. Upon completion, each system shall be tested as an entire system.
- C. Repair or replace defects, leaks and material failures revealed by tests and then retest until satisfactory. Make repairs with new materials.
- D. All systems shall hold scheduled test pressures for specified time without loss of initial test pressure.
- E. Upon completion of testing submit five copies of a typewritten report to A/E. Report shall list systems tested, test methods, test pressures, holding time and all failures with corrective action taken.
- F. For test pressure schedules see piping material schedules.

#### 3.2. TEST METHODS AND PRESSURES

- A. Test methods and pressures shall be as follows:
  - 1. Hydrostatic Test (Closed Systems):
    - a. Hydrostatic test shall be performed using clean unused domestic water. Test pressures shall be as scheduled for system or 150% of operating pressure where not specified.
  - 2. Pneumatic Test:
    - a. Test entire system with compressed air. Systems operating above 25 PSI shall be tested at 75 PSI or 15% of operating pressure or whichever is greater.
    - b. Allow at least 1 hour after test pressure has been applied before making initial test.
    - c. Curing test, completely isolate entire system from compressor or other sources of air pressure.
  - 3. Pressure Relief and Safety Valve:
    - a. Before installation, test pressure temperature, and safety relief valves to confirm relief settings comply with specifications.
    - b. Tag items that pass test with date of test, observed relief pressure setting and inspector's signature.
    - c. Items installed in systems without test tag attached will be rejected.

#### 3.3. TESTING OF REFRIGERANT LINES

- A. After the system is installed and before any piping is insulated, the entire refrigeration circuit must be thoroughly leak tested. Test all pipe joints for leaks. Make certain that all joints are inspected thoroughly. Mark carefully any spots where leaks occur.
- B. Leaks are repaired by disassembling the connection, cleaning the fitting and remaking. No attempt should be made to repair a leak by simply adding brazing material.

#### 3.4. MISCELLANEOUS CONTROL WIRING

- A. All control wiring regardless of voltage shall be routed in a concealed manner.
- B. All exterior control wiring shall be installed in conduit.
- C. Wiring to thermostats and other wall mounted devices and sensors shall be routed in ¾" conduit to backboxes in walls and to an accessible ceiling or location.

- D. All conduit and wiring shall be installed in accordance with Division 26.
- E. Cabling and circuiting shall be plenum rated where required.
- F. Refer to additional specifications where systems and controls are specified as DDC or similar.

### 3.5. CLEANING OF SYSTEMS AND EQUIPMENT

- A. After pressure testing of systems and equipment and before operational test thoroughly clean interiors of piping and equipment. Clean equipment as recommended by equipment manufacturers. Where specific instructions are not provided clean equipment systems as follows:
  - 1. Air Handling Systems:
    - a. Before starting any air system clean all debris, foreign matter and construction dirt from air system and fan. Provide equipment requiring filters, such as air handling units, fan coil units, blower, etc., with throw-away filters. After cleaning air system install temporary filters and run continuously for a minimum of eight hours at full volume before installing permanent filters. Provide temporary throw-away filters in all permanent heating and air conditioning equipment systems being utilized during construction. Prior to testing and balancing systems remove temporary filter media and install clean unused filters of the type specified. Clean filters shall be installed in equipment by mechanical contractor before final acceptance inspection by Architect and Engineer.

### 3.6. MAINTENANCE OF SYSTEMS

- A. Contractor shall be responsible for operation, maintenance and lubrication of equipment installed under this contract.
- B. Keep a complete record of equipment maintenance and lubrication and submit two copies with request for final construction review.
- C. Records shall indicate types of lubricants used and date or time when next maintenance or lubrication will need to be performed by Owner. Where special lubricants are required, Contractor shall provide Owner with a one year supply as determine by Equipment Manufacturer's recommendations.

### 3.7. PAINTING OF MATERIALS AND EQUIPMENT

- A. Touch-up painting and refinishing of factory applied finishes shall be by Mechanical Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
- B. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
- C. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
- D. Where extensive refinishing is required equipment shall be completely repainted.

### 3.8. EXCAVATION AND BACKFILL

- A. Perform necessary excavation to receive Work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove it at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
- C. Conduct excavations so no walls or footings are disturbed or injured. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by Architect-Engineer. Mechanically tamp backfill under concrete and pavings in six inch layers to 95% standard density, Reference Division 2.
- D. Backfill trenches and excavations to required heights with allowance made for settlement. Tamp fill material thoroughly and moistened as required for specified compaction density. Dispose of excess earth, rubble and debris as directed by Architect.
- E. When available, refer to test hole information on Architectural or Civil drawings or specifications for types of soil to be encountered in excavations.

### 3.9. FIRE BARRIERS

- A. General
  - 1. For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Submittals

1. Product Data: For Each Type Of Product Indicated.
  2. Shop Drawings: For Each Through-Penetration Firestop System, Show Each Type Of Construction Condition Penetrated, Relationships To Adjoining Construction, And Type Of Penetrating Item. Include Firestop Design Designation Of Qualified Testing And Inspecting Agency That Evidences Compliance With Requirements For Each Condition Indicated.
    - a. Submit Documentation, Including Illustrations, From A Qualified Testing And Inspecting Agency That Is Applicable To Each Through-Penetration Firestop System Configuration For Construction And Penetrating Items.
    - b. Where Project Conditions Require Modification To A Qualified Testing And Inspecting Agency's Illustration For A Particular Through-Penetration Firestop Condition, Submit Illustration, With Modifications Marked, Approved By Through-Penetration Firestop System Manufacturer's Fire-Protection Engineer As An Engineering Judgment Or Equivalent Fire-Resistance-Rated Assembly.
  3. Through-Penetration Firestop System Schedule: Indicate Locations Of Each Through-Penetration Firestop System, Along With The Following Information:
    - a. Types Of Penetrating Items.
    - b. Types Of Constructions Penetrated, Including Fire-Resistance Ratings And, Where Applicable, Thicknesses Of Construction Penetrated.
    - c. Through-Penetration Firestop Systems For Each Location Identified By Firestop Design Designation Of Qualified Testing And Inspecting Agency.
  - C. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
  - D. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
  - E. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
  - F. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by building inspector, if required by authorities having jurisdiction.
  - G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.
  - H. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
  - I. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated.
  - J. Provide sleeves through all fire-rated walls and fill voids surrounding sleeves and interior to sleeves around piping with Nelson "Flameseal" fire stop putty with U.L. listed 3 hour rating installed as per manufacturers recommendations.
  - K. Equivalent by Hilti, Inc., Johns Manville, Nelson Firestop Products, NUCO Inc., RectorSeal Corporation, Specified Technologies Inc., 3M, Tremco, USG, Dow, Chemelex.
- 3.10. EQUIPMENT ANCHORS
- A. Provide floor or foundation mounted equipment such as pumps, boilers, air handling units, etc. with Decatur Engineering Company concrete anchors.
  - B. Where equipment anchors cannot be installed during forming of floors or foundations anchor equipment with McCulloch Kwik-Bolt concrete anchors.
  - C. Anchors shall be proper type and size recommended by manufacturer for equipment to be anchored.
- 3.11. WELDING
- A. Contractor shall be responsible for quality of welding and suitability of welding procedures. All welding shall be in accordance with American Welding Society Standard B3.0 and ANSI Standard B31.1.
  - B. Welded pipe joints shall be made by certified welding procedures and welders. Welding electrodes shall be type and material recommended by electrode manufacturer for materials to be welded. All pipe and fittings ends shall be beveled a minimum of 30 degrees prior to welding.
  - C. Only welders who have successfully passed welder qualifications tests in previous 12 months for type of welding required shall do welding. Each welder shall identify his work with a code marking before starting any welded pipe fabrication. Contractor shall submit three copies of a list of welders who will work on project listing welders' code, date and types of latest qualification test passed by each welder.
  - D. Welded joints shall be fusion welded in accordance with Level AR3 of American Welding Society Standard

AWS D10.9 "Standard for Qualification of Welding Procedures and Welders for Pipe and Tubing". Welders qualified under National Certified Pipe Welding Bureau will be acceptable.

- E. Bevel all piping and fittings in accordance with recognized standards by flame cutting or mechanical means. Align and position parts so that branches and fittings are set true. Make changes in direction of piping systems with factory made welding fittings. Make branch connections with welding tees or forged weldolets.

**END OF SECTION 230011**

## SECTION 230013 – PROJECT COORDINATION

### 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 administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Administrative and supervisory personnel.
  - 3. Project meetings.
  - 4. Requests for Interpretation (RFIs).
- B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

#### 1.3. COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Delivery and processing of submittals.
  - 2. Progress meetings.
  - 3. Preinstallation conferences.
  - 4. Project closeout activities.
  - 5. Startup and adjustment of systems.

#### 1.4. SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
  - 1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
    - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate required installation sequences.
    - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  - 2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.

3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

#### 1.5. COORDINATION

- A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.
- B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
- C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
- D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
- E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.
- F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
- G. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.
- H. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.
- I. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.
- J. Adjust location of piping, ductwork, conduit, wiring, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

##### 1. Right-of-Way:

- a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
- b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

#### 1.6. DRAWINGS AND FILES

- A. The Drawings show only the general run of MEP systems, equipment, fixtures, piping and ductwork and other components as well as approximate location of items such as outlets, switches, diffusers, lights, and equipment connections, etc. Coordinate all exact locations of items with other trades, architectural elevations, equipment requirements, owner requirements, ceilings, access, serviceability, etc. All such modifications and coordination shall be made without additional cost to the Owner. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made
- B. Wherever the work is of sufficient complexity, additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field. Attend meetings with other trades to review all documents.
- C. When directed by the General Contractor for areas of necessary coordination provide 3D building modelling coordination files and documents with other trades. Transmit information electronically and attend meetings as directed by the G/C as well as take part in coordination activities and documentation. Contractor shall be required to generate their own electronic files for this process.

### 1.7. PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
  - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Possible conflicts.
    - i. Compatibility problems.
    - j. Time schedules.
    - k. Manufacturer's written recommendations.
    - l. Warranty requirements.
    - m. Compatibility of materials.
    - n. Space and access limitations.
    - o. Regulations of authorities having jurisdiction.
    - p. Testing and inspecting requirements.
    - q. Installation procedures.
    - r. Coordination with other work.
    - s. Required performance results.
    - t. Protection of adjacent work.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  - 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.
    - b. Review present and future needs of each contractor present, including the following:
      - i. Interface requirements.

- ii. Sequence of operations.
  - iii. Status of submittals.
  - iv. Deliveries.
  - v. Off-site fabrication.
  - vi. Access.
  - vii. Quality and work standards.
  - viii. Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.8. REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.
- 1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  - 2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

**END OF SECTION 220013**

## SECTION 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC SYSTEMS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### PART 2 - PRODUCTS

#### 2.1. MOTORS

- A. Motors shall be installed in strict accordance with rules set forth by NEC and equipment manufacturer.
- B. ELECTRIC MOTORS (Less than ½ HP)
  - 1. Motors 1/3 horsepower and smaller shall be selected by manufacturer of driven equipment with motor speed and torque characteristics best suited for application.
  - 2. Motors shall have a minimum service factor of 1.15 for open dripproof enclosure and 1.00 for totally enclosed motors. Wherever applicable provide motors with cushion bases. Motor enclosure shall be proper type required for operating environment.
  - 3. Motors shall have a plus or minus 10% voltage tolerance and plus or minus 5% frequency tolerance. Motors shall operate satisfactorily in ambient temperature range of 0 degrees C (32°F) to 140°C (104°F) at altitudes below 3300 feet.
  - 4. Provide motors with built-in thermal overload protection. Motors readily accessible to operating personnel shall have manual reset protector. All other shall have automatic reset protectors.
  - 5. Motors shall have AFBMA standard double-shielded ball bearings sized for average life of at least 100,000 hours under normal loading conditions. Bearings housing shall have provisions for adding new lubricant without major disassembly and shall have seals to prevent entrance of foreign matter and leakage of bearing lubricant.
  - 6. Motor bolts, screws and other external hardware shall be treated with corrosion resistant plating and motor enclosure prime painted with corrosion resistant metal primer finished with a durable machinery enamel.
  - 7. Unless indicated otherwise motors shall be rated for continuous operation at 115, 200, or 277 volt single phase 60 hertz. Where equipment manufacturer offers a choice provide permanent split capacitor motors in lieu of shaded pole motors.
  - 8. Motor leads shall be marked throughout entire length for easy identification and terminate with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
- C. ELECTRIC MOTORS (1/2 HP and Larger)
  - 1. Provide equipment requiring electric motors with NEMA Standard motors. Shop drawings, submitted and equipment provided with electric motors shall include motor manufacturer, horsepower, voltage, full load amperes, NEMA design type, insulation class, shaft bearing type, mounting base type, and enclosure type. To greatest extent possible motors for this project shall be by one manufacturer.
  - 2. Motors shall conform to current NEMA Standard MG1. Motor shall operate successfully without derating under the following conditions.
  - 3. 40 degrees C (104°F) maximum ambient temperature, 3,300 Ft. maximum altitude, voltage variations of plus or minus 10% of nameplate rating, frequency variations of plus or minus 5% of nameplate rating, combined voltage and frequency variation of plus or minus 10% total as long as frequency does not exceed plus or minus 5%.
  - 4. Motors shall meet or exceed locked rotor (Starting) and breakdown (maximum) torques specified for the NEMA design rating. Lock rotor currents shall not exceed NEMA maximum values for motor NEMA design rating.
  - 5. Motor service factors shall be 1.15 for open dripproof motors and 1.00 for totally enclosed motors.
  - 6. Unless indicated otherwise, motor insulation may be manufacturers standard for Class A, B or F provided that maximum permissible temperature for insulation is not exceeded when motor is operating at its service factor load in a 40 Degrees C (104°F) ambient.
  - 7. Motor frame/HP relationship shall conform to current NEMA Standard for "T" frames. Motors shall have antifriction ball or roller bearings sized for average life of at least 100,000 hours under normal v-belt loading conditions. Bearings shall be AFBMA Standard and shield mounted ball bearings of ample capacity for motor rating. Bearing housing shall have provisions for adding new lubricant and draining out old lubricant without major motor disassembly. Bearing housing shall have seals to protect bearing from entrance of foreign matter and to prevent leakage of bearing lubricant.
  - 8. Conduit box mounting shall rotate to allow conduit entrance from top, bottom or either side. Conduit

- holes shall conform to NEC Standards.
9. Motor leads shall have same insulation class as motor windings. Leads shall be marked throughout entire length for easy identification and terminated with brass or copper terminal lugs. Motor shall have permanently attached nameplate with electrical characteristics and wiring connection diagram.
  10. Motor bolts, screws and other external hardware shall be treated with a corrosion resistant plating. Motor enclosure shall be prime painted with corrosion resisting metal primer and finished with a durable machinery enamel paint.
  11. Unless indicated otherwise motors shall be rated for continuous operation at rated voltage, three phase, 60 hertz. Motors shall be T-frame squirrel cage induction. Type NEMA design B with Class B insulation. Motors shall be dripproof totally enclosed or explosion-proof as required by motor environment.

PART 3 – EXECUTION (NOT APPLICABLE)

**END OF SECTION 230513**

## SECTION 230514 – MOTOR CONTROL AND EQUIPMENT DISCONNECTS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 220010.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of disconnect to be furnished.
- B. Dimensional Drawings: For each respective type and size of disconnect.

### PART 2 - PRODUCTS

#### 2.1. MANUFACTURERS

- A. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.

#### 2.2. DISCONNECT SWITCHES

- A. Provide heavy-duty horsepower rated Safety Switches rated in accordance with NEMA enclosed Switch Standard KS 1-1969 and L98 Standard.
- B. Enclosure shall be NEMA type and material required by switch location and environment. Enclosure door shall latch with means for padlocking and cover interlock with defeater to prevent opening door when switch is energized or closing switch with door open. Switch shall have an embossed nameplate permanently attached to door front with switch rating, short circuit interrupting capacity and application information.
- C. Line terminals shall be permanently marked and shielded. Contact shall be tin plated, equipped with arch chutes and have movable contacts visible in off position with door open. Wiring terminals shall be pressure type suitable for copper or aluminum wire. Switching mechanism shall be quick-make, quick-break spring driven anti-tease mechanism and shall be integral part of box. All current carrying parts shall be plated.
- D. Fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.

#### 2.3. MOTOR STARTERS - GENERAL

- A. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.

#### 2.4. MAGNETIC MOTOR STARTERS

- A. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
- B. Enclosures shall be NEMA type required by starter location and environment.
- C. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.
- D. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.
- E. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
- F. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.
- G. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.
- H. Provide each starter with two auxiliary contacts. Starter shall be suitable for addition of at least an additional two electrical interlocks of any arrangement of normally open or closed contacts.
- I. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.
- J. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.

## 2.5. COMBINATION MAGNETIC MOTOR STARTERS

1. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
2. Starter NEMA enclosure type shall be type required for starter location and environment.
3. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
4. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.
5. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.
6. See plans for combination magnetic starters.

## 2.6. MANUAL MOTOR CONTROL (1 HP Maximum)

- A. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.
- B. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
- C. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.
- D. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.

## PART 3 EXECUTION

### 3.1. INSTALLATION

- A. All fuse holders shall have rejection clips installed.
- B. Mount starter enclosure rigidly and with proper alignment on building structure or steel supports with operating switches not more than 6 feet above finished floor unless otherwise required. Use steel supports fabricated from standard rolled structural steel shapes or framing channel to provide one-inch separation between enclosure and building wall for vertical flow of air.
- C. Furnish and install a nameplate for each starter/switch engraved with the equipment designation which the disconnect serves.
- D. All starters/disconnect switches as specified shall be installed in strict accordance with rules set forth by NEC.
- E. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and manufacturer's installation requirements.

**END OF SECTION 230514**

## SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1. SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.

#### 1.2. SUBMITTAL

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1. EQUIPMENT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware. Black letters on white background.
- B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- C. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- D. Fasteners: Stainless-steel rivets or self-tapping screws.
- E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- F. 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.
- G. Install or permanently fasten labels on each major item of mechanical equipment.
- H. Locate equipment labels where accessible and visible.

#### 2.2. PIPING IDENTIFICATION

- A. Colors and wording shall be of standard pipe markers as available from Seaton or equal. Submit for approval list of colors and wording prior to purchase of pipe markers.
- B. Pipe marker nomenclature/colors shall meet applicable ANSI Standard and OSHA requirements. Pipe markers with letters and flow direction arrows
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

**END OF SECTION 230553**

## SECTION 230713 – DUCT INSULATION

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUMMARY

##### A. Section Includes:

- 1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Sealants.
- 6. Factory-applied jackets.
- 7. Field-applied jackets.
- 8. Tapes.

#### 1.3. SUBMITTALS

- 1. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- 2. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

##### B. QUALITY ASSURANCE

- 1. 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.
  - a. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - b. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- 2. Products shall not contain formaldehyde, asbestos, lead, mercury, mercury compounds, or polybrominated diphenyl ether fire retardants.

#### 1.4. DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.5. COORDINATION

- A. Coordinate clearance requirements with duct Installer for duct insulation application and equipment Installer for equipment insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- B. All ductwork shall be provided with insulation meeting the requirements of the energy code for exterior and interior requirements. All ductwork shall be insulated to prevent condensation.
- C. Refer to insulation schedule for additional information in addition to these requirements.
- D. All exterior insulation shall be provided with a jacket.

## 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 that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

### 2.2. DUCT LINER

- A. Fibrous-Glass Duct Liner (Flat Applications): Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Knauf Insulation; Atmosphere Duct Liner with ECOSE Technology
    - b. CertainTeed Corporation; Insulation Group.
    - c. Johns Manville.
    - d. Owens Corning.
    - e. Manson Insulation; Akousti-Liner Duct Liner with ECOSE Technology.
  - 2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Fibrous-Glass Duct Liner (Round Applications): Engineered, pre-formed insulation designed for specific duct diameters and fittings. Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard." Rigid, resin bonded fibrous glass board with a damage-resistant, flame retardant veil faced airstream surface with a reinforced aluminum foil (FRK) backing.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Knauf Insulation; Atmosphere Duct Liner with ECOSE Technology
    - b. CertainTeed Corporation; Insulation Group.
    - c. Johns Manville.
    - d. Owens Corning.
    - e. Manson Insulation; Akousti-Liner Duct Liner with ECOSE Technology.
  - 2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- C. Fiber-Free Duct Liner (Flat Applications): Polyester blanket insulation with FSK facing. Comply with ASTM C 1071, NFPA 90A, or NFPA 90B.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ductmate.
  - 2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
  - 4. Duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing. Liner must have a noise reduction coefficient of at least 0.65 and have thermal values greater or equal to an R-4.2 at 1", R-5 at 1.25", R-6 at 1 Yi" and R-8 at 2" respectively.
  - 5. Polyester liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard Environmental Institute, and contain zero VOCs per ASTM D5116. Liner must comply with all applicable standards including ASTM E84, ASTM C518, ASTM G-21, NFPA 90A

- and 90B, and UL 181.
6. Polyester duct liner must be attached using a non-flammable, low VOC water based adhesive. When applicable, apply a non-flammable, low VOC water based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HV AC Duct Liner installation instructions. Liner must consist of at least 25% recycled content.
  7. Polyester duct liner must be installed per section 7.4 of the 2005 SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible," Third Edition unless otherwise specified
- D. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 1534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA Inc.
    - b. Armacell LLC.
    - c. Rubatex International, LLC
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

### 2.3. DUCT WRAP

- A. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. 1.0 lb. density standard duct insulation type IV with foil-scrim-craft facing and .27 BTUH thermal conductivity at 75 degrees mean temperature.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Atmosphere Duct Wrap with ECOSE Technology (Basis of Design Product).
    - d. Manson Insulation Inc.; Alley Wrap B with ECOSE Technology.
    - e. Owens Corning; All-Service Duct Wrap.
- B. 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.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Johns Manville; 800 Series Spin-Glas.
    - c. Knauf Insulation; Earthwool Insulation Board with ECOSE Technology (Basis of Design Product).
    - d. Manson Insulation Inc.; AK Board with ECOSE Technology.
    - e. Owens Corning; Fiberglas 700 Series.
- C. Flexible Elastomeric Duct Wrap: Closed cell insulation with a 16 mil laminated covering membrane (a UV protective white or silver, blended polymeric top surface and a puncture-resistant blended polymeric base, around a scrim reinforced core). The membrane has a 10-year limited warranty against breakdown due to UV radiation. Mold-resistant flexible elastomeric thermal insulation. It is manufactured without the use of CFCs, HFCs or HCFCs.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armacell LLC ArmaTuff Plus II.
  2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- D. Fire-Rated Insulation Systems
1. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.
  2. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; FlameChek.
- b. Johns Manville; Firetemp Wrap.
- c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
- d. Thermal Ceramics; FireMaster Duct Wrap.
- e. 3M; Fire Barrier Wrap Products.
- f. Unifrax Corporation; FyreWrap.
- g. Vesuvius; PYROSCAT FP FASTR Duct Wrap.

E. Insulation Pins and Washers:

- a. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated with integral 1-1/2-inchgalvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

2.4. INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.5. 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.
1. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- D. PVC Jacket Adhesive: Compatible with PVC jacket.

2.6. MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 180 deg F.
  3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 200 deg F.
  3. Solids Content: 63 percent by volume and 73 percent by weight.
  4. Color: White.

2.7. 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.
  5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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.
  5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.8. 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.

## 2.9. FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
  - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Division 01 Section "Product Requirements."
  - 2. Factory cut and rolled to size.
  - 3. Finish and thickness are indicated in field-applied jacket schedules.
  - 4. Moisture Barrier for Indoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - 5. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
  - 6. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. End caps.
    - c. Beveled collars.
    - d. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.10. 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.
- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches.
  - 2. Thickness: 3.7 mils.
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.

## PART 3 – EXECUTION

### 3.1. EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2. PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3. INSULATION SCHEDULE

- A. Refer to drawings for insulation and ductwork schedule.

### 3.4. 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 duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
  - D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
  - E. Install multiple layers of insulation with longitudinal and end seams staggered.
  - F. Keep insulation materials dry during application and finishing.
  - G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
  - H. Install insulation with least number of joints practical.
  - I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
    - 1. Install insulation continuously through hangers and around anchor attachments.
    - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
    - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
  - K. Install insulation with factory-applied jackets as follows:
    - 1. Draw jacket tight and smooth.
    - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
    - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - 4. For below ambient services, apply vapor-barrier mastic over staples.
    - 5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
    - 6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
  - L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
  - M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
  - N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
  - O. For above ambient services, do not install insulation to the following:
    - 1. Vibration-control devices.
    - 2. Testing agency labels and stamps.
    - 3. Nameplates and data plates.
    - 4. Access doors.
  - P. Undamaged insulation systems on cold surface ductwork and equipment shall perform their intended functions as vapor barriers and thermal insulation without premature deterioration of insulation or vapor barrier. Contractor shall take every reasonable precaution to provide insulation systems with continuous unbroken vapor barriers.
  - Q. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
    - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
    - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
    - 3. Butt transverse joints without gaps, and coat joint with adhesive.
    - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
    - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
    - 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
    - 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
    - 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following

locations:

- a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. For double wall ductwork, secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
- a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

### 3.5. PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. 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 Penetration Firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Penetration Firestopping."

### 3.6. 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 50 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.
- B. 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.
1. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  2. 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.
- C. 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.
- D. 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.
- E. 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.

F. 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 50 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.

3.7. 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.

3.8. EXTERIOR FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. install using manufacturer recommended adhesives or with pre-applied pressure sensitive adhesive (PSA) for application to large, flat or curved metal surfaces such as ducts, vessels, very large pipes or tanks.
- B. The seams must be installed in compression and sealed with adhesives. Adhesives are contact adhesives and shall be applied to duct and insulation surfaces.
- C. Cover seams with manufactured Seal Tape specific for application matching jacket.
- D. Exterior duct work must be pitched to allow rain water to run off the insulation.
- E. Do not install below ground.
- F. The application temperature should be above 40°F (+4°C) and 100°F (+38°C).

3.9. FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by

insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.10. FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.11. FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. 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 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, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
- E. Insulation failing to meet workmanship and appearance standards shall be replaced with an acceptable installation before final acceptance of project will be given. Insulation failing to meet performance requirements of this specification for a period of one year after date of final acceptance or through one heating season and one cooling season, whichever is longer shall be replaced with an acceptable installation. All costs to correct insulation deficiencies and costs to repair damages to other work shall be at Mechanical Contractors expense at no cost to owner.

### 3.12. FIELD QUALITY ASSURANCE

- A. Upon completion of insulation work and before operation is to commence, visually inspect the work and verify that it has been correctly installed.
- B. Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct system. Allow for a means of removal of such material.
- C. Check the duct system to ensure that there are no air leaks through joints.

### 3.13. PROTECTION

- A. Replace damaged insulation, which cannot be satisfactorily repaired, including insulation with duct liner damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

**END OF SECTION 230713**

SECTION 230913 – PROGRAMMABLE THERMOSTATS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2. SUBMITTALS

- A. Product Data: For each control device indicated.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- B. Operation and maintenance data.

PART 2 PRODUCTS

2.1. GENERAL

- A. Provide Thermostats by Honeywell, Johnson Controls, White-Rogers, Carrier or approved equal.

2.2. UNITS

- A. Provide programmable thermostats with stages of cooling and heating as required by stages of cooling and heating on specified equipment (Refer to drawings and other portions of this specification to determine exact control required.)
- B. Thermostat shall have the following:
  - 1. Seven (7) day programming capability with 2 occupied/unoccupied periods per day.
  - 2. Automatic heat/cool change over.
  - 3. Start time optimization
  - 4. Continuous fan operation in occupied mode.
  - 5. Intermittent fan operation in unoccupied mode.
  - 6. Battery backup
  - 7. Temporary override capability
  - 8. Locking setpoints to prevent tampering.
  - 9. Anti-recycle controls
- C. Provide with all subbases required and interfaces to other equipment as required.

PART 3 EXECUTION

3.1. INSTALLATION

- A. Coordinate with Electrical Contractor to provide all wiring between condensing units, furnaces, thermostats and all other required controls.
- B. Provide backbox and ¾" conduit to above accessible ceilings inside walls for thermostat wiring.
- C. All wiring shall be concealed in conduit or above accessible ceilings.
- D. Obtain a desired operational schedule from the owner or tenant and program each thermostat with desired settings.
- E. Provide Thermostats by Honeywell, Johnson Controls, White-Rogers, Carrier or approved equal.

**END OF SECTION 230913**

## SECTION 233113 – METAL DUCTS

### PART 1 GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUMMARY

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round and flat-oval ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.

#### 1.3. PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

#### 1.4. SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
  - 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
  - 1. Sheet metal thicknesses.
  - 2. Joint and seam construction and sealing.
  - 3. Reinforcement details and spacing.
  - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  - 2. Suspended ceiling components.
  - 3. Structural members to which duct will be attached.
  - 4. Size and location of initial access modules for acoustical tile.
  - 5. Penetrations of smoke barriers and fire-rated construction.
  - 6. Items penetrating finished ceiling including the following:

- a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.
- E. Welding certificates.
- F. Field quality-control reports.

## PART 2 PRODUCTS

### 2.1. SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct allowing for insulation if lined.

### 2.2. SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Lindab Inc.
  - b. McGill AirFlow LLC.
  - c. SEMCO Incorporated.
  - d. Sheet Metal Connectors, Inc.
  - e. Spiral Manufacturing Co., Inc.
  - f. Norlock Metal Products, Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. All exposed round ducts shall be spiral wound construction.
- G. Concealed low pressure round ducts may be snap-lock construction when 8" or less. 10" round ducts shall be spiral wall construction.

### 2.3. ELBOW CONFIGURATION:

- A. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
1. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
- B. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

1. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
  - a. Radius-to Diameter Ratio: 1.5.
2. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
3. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

#### 2.4. BRANCH CONFIGURATION:

- A. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
  1. Rectangular Main to Rectangular Branch: 45-degree entry.
  2. Rectangular Main to Round Branch: High Efficiency 45 degree takeoff.
- B. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
  1. Velocity 1000 fpm or Lower: 90-degree tap.
  2. Velocity 1000 to 1500 fpm: Conical tap.
  3. Velocity 1500 fpm or Higher: 45-degree lateral.

#### 2.5. SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  1. Galvanized Coating Designation: G90.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.

#### 2.6. SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Sealant: Modified styrene acrylic.
  3. Indoor and outdoor, Water resistant, Mold and mildew resistant.
  4. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- C. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Indoor or outdoor, Water resistant, Mold and mildew resistant.
  5. VOC: Maximum 75 g/L (less water).
  6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
- D. Solvent-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solids Content: Minimum 60 percent.
  4. Indoor or outdoor, Water resistant, Mold and mildew resistant.
  5. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
  1. General: Single-component, acid-curing, silicone, elastomeric.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.
- H. Pressure sensitive duct joint sealer:
1. Provide Hard Cast, Inc. "Foil Grip" pressure sensitive duct joint sealer. Seal class "A", "B", and "C".

## 2.7. HANGERS AND SUPPORTS

- A. Indicate the extent of corrosive environment on Drawings.
- B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- C. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- D. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- I. Trapeze and Riser Supports:
  1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 EXECUTION

### 3.1. DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. All metal ductwork scheduled for interior thermal and acoustical liner is not sized on plans to include the proper thickness of insulation. Add 1" or 2" in height and width of ductwork as required to accommodate insulation thickness. Mount specialties such as turning vanes, dampers, etc., to ductwork with that section insulated "Build Outs" to maintain continuity of thermal barrier.
- D. All ductwork within 15 feet of connection to rooftop units shall be constructed to 6" WG class regardless of unit static pressure ratings and be a minimum of 18 gauge sheet metal. Roof deck shall only be cut out as required for ductwork penetrations and annular gap around duct shall be sealed with elastomeric caulk to reduce rooftop unit breakout noise.
- E. Install round and flat-oval ducts in maximum practical lengths.
- F. Install ducts with fewest possible joints.
- G. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- H. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- I. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- J. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- K. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- L. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- M. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- N. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

### 3.2. INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3. DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the scheduled seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
- C. In residential occupancies duct tightness shall be verified by either of the following:
  - 1. Postconstruction test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m<sup>2</sup>) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test.
  - 2. Rough-in test: Total leakage shall be less than or equal to 4 cfm (113.3 L/min) per 100 square feet (9.29 m<sup>2</sup>) of conditioned floor area when tested at a pressure differential of 0.1 inches w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure. All registers shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 3 cfm (85 L/min) per 100 square feet (9.29 m<sup>2</sup>) of conditioned floor area.
  - 3. Exception: The total leakage test is not required for ducts and air handlers located entirely within the building thermal envelope.

### 3.4. HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5. CONNECTIONS

- A. Coordinate duct installations and specialty arrangements with Drawings.
- B. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- C. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6. PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application

requirements are specified in Division 09 painting Sections.

### 3.7. FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
  - 3. Duct system will be considered defective if it does not pass tests and inspections.
  - 4. Prepare test and inspection reports.

### 3.8. START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

### 3.9. DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

SYSTEM	Material	Pressure Class	Min. SMACNA Seal Class	Leakage Class
Supply				
Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units	Galv. SM	2" Pos.	C	Round-3 Rect-6
Return				
Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units	Galv. SM	2" Neg.	C	Round-3 Rect-6
Exhaust				
Ducts Connected to General Exhaust	Galv. SM	2" Pos. or Neg.	B	Round-3 Rect-6
Outside Air				
Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units	Galv. SM	2" Neg.	C	Round-3 Rect-6

**END OF SECTION 233113**

## SECTION 233300 – AIR DUCT ACCESSORIES

### PART 1 GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Wiring Diagrams: For power, signal, and control wiring.
  - 2. Operation and maintenance data.
- C. QUALITY ASSURANCE
  - 1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
  - 2. Comply with AMCA 500-D testing for damper rating.

### PART 2 PRODUCTS

#### 2.1. MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

#### 2.2. BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Air Balance Inc.
  - 2. Cesco Products.
  - 3. Duro Dyne Inc.
  - 4. Greenheck Fan Corporation.
  - 5. Nailor Industries Inc.
  - 6. NCA Manufacturing, Inc.
  - 7. Pottorff, a division of PCI Industries, Inc.
  - 8. Ruskin Company.
  - 9. SEMCO Incorporated.
  - 10. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- E. Blade Action: Parallel.
- F. Blade Seals: Neoprene, mechanically locked.
- G. Blade Axles: Nonferrous metal.
- H. Tie Bars and Brackets: Galvanized steel.
- I. Return Spring: Adjustable tension.

- J. Bearings: Steel ball or synthetic pivot bushings.
- K. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Electric actuators.
  - 4. Chain pulls.
  - 5. Retain one of first two subparagraphs below.
  - 6. Screen Mounting: Front mounted in sleeve.
    - a. Sleeve Thickness: 20-gage minimum.
    - b. Sleeve Length: 6 inches minimum.
- L. Screen: Rear mounted. Galvanized steel. Bird.
- M. 90-degree stops.

### 2.3. MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance Inc.
    - b. Flexmaster U.S.A., Inc.
    - c. McGill AirFlow LLC.
    - d. METALAIRE, Inc.
    - e. Nailor Industries Inc.
    - f. Pottorff, a division of PCI Industries, Inc.
    - g. Ruskin Company.
    - h. Vent Products Company, Inc.
  - 2. Suitable for horizontal or vertical applications.
  - 3. Frames: Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness. Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 4. Blades: Multiple or single blade. Parallel blade design for mixing applications and opposed-blade design for balance only applications. Stiffen damper blades for stability. Galvanized-steel, 0.064 inch thick.
  - 5. Blade Axles: Galvanized steel.
  - 6. Bearings: Molded synthetic. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 7. Tie Bars and Brackets: Galvanized steel.
- B. Jackshaft:
  - 1. Size: 1-inch diameter.
  - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
  - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

### 2.4. TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. METALAIRE, Inc.
  - 4. SEMCO Incorporated.
  - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- C. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.5. DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cesco Products; a division of Mestek, Inc.
  2. Ductmate Industries, Inc.
  3. Flexmaster U.S.A., Inc.
  4. Greenheck Fan Corporation.
  5. McGill AirFlow LLC.
  6. Nailor Industries Inc.
  7. Pottorff; a division of PCI Industries, Inc.
  8. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
1. Door:
    - a. Double wall, rectangular. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. 1-by-1-inch butt or piano hinge and cam latches.
    - b. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
    - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

## 2.6. FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.
  3. Ventfabrics, Inc.
  4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
1. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene. 26 oz./sq. yd. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

## 2.7. LOW PRESSURE FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
  2. McGill AirFlow LLC.
  3. Thermaflex
  4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Low Pressure Flexible Duct
1. Thermaflex M-KE rated for +6" W.G. max. and -1" W.G. max. for duct sizes 4" to 14", +6" W.G. max. and -0.5" W.G. max for duct sizes 14" to 16", +4" W.G. max. and -0.5" W.G. max for duct sizes 18" to 20". Rated for 3500 FPM maximum velocity. UL listed "UL-181 Standards Class I Duct Material" complying with NFPA Standards 90A and 90B. Duct shall be composed of an acoustically rated inner polymeric liner duct bonded to coated steel wire helix. Fiberglass insulation and tear resistant metalized polyester film outer vapor barrier. Maximum flexible duct length or run shall be 5'-0" unless otherwise noted. Flexible ductwork shall be securely attached to both the rigid duct connection and diffuser neck with plastic band clamps or stainless steel worm driven clamps. Equivalent by Wiremold, Cleavaflex, Flexmaster.

## 2.8. DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 EXECUTION

### 3.1. INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At drain pans and seals.
  - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 6. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- J. Install flexible connectors to connect ducts to equipment.
- K. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- L. Retain first paragraph below to allow use of flexible duct to connect terminal units to metal duct.
- M. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- N. Connect flexible ducts to metal ducts with draw bands.
- O. Install duct test holes where required for testing and balancing purposes.

### 3.2. FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Inspect turning vanes for proper and secure installation.

**END OF SECTION 233300**

## SECTION 233400 – HVAC FANS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
- 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.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

### PART 2 PRODUCTS

#### 2.1. CENTRIFUGAL POWER ROOF VENTILATOR

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Loren Cook Company.
  - 2. Greenheck.
  - 3. Penn Ventilation.
  - 4. Twin City.
  - 5. Hartzell
- B. Ventilator covers shall be aluminum specifically designed to withstand high wind loads. Wheels 12" in diameter and larger shall have air foil or medium foil blades. The motor and drive compartment shall be positively externally ventilated. Drive components shall be isolated from the structure. Bearings shall be designed for 200,000 hours operation.
- C. Horsepower shall not exceed the values shown and oversize motors will not be acceptable.
- D. Ventilators shall be furnished with acceptable electrical disconnect and birdscreen. Single phase motors shall have integral overload protection. V-belt drives shall be adjustable.
- E. PSC motors shall be provided with speed controllers to be mounted at the fan.
- F. ECM motors shall be provided with integral speed control adjustment or 0-10V speed control interface for speed control. Coordinate speed control method with controls contractor.
- G. Provide power open/spring closed electric motorized low leak backdraft dampers to open when fan motor is started. When motor voltage differs from damper motor voltage, provide control power transformer with appropriate fusing to operate damper motor. Provide any necessary control relays to operate associated dampers.
- H. Belt driven fans shall be provided with automatic belt tensioners to maintain proper belt tension.
- I. Direct drive fans shall be supplied with speed controls and located at the fan. This speed control shall be furnished to electrical contractor for mounting.
- J. Provide single phase motor equipped fans with motor rated start relay. Provide multiphase motor equipped fans with magnetic motor starter as specified in SECTION 230514 – MOTOR CONTROL AND EQUIPMENT DISCONNECTS. Coordinate location of starter with other trades.
- K. Provide local electrical disconnecting means for all fans.
- L. Provide minimum 14" tall roof curb designed to mate with the unit and provide support and a watertight installation. Verify thickness of insulation at each unit and provide curb extension or taller curb to maintain top of curb a minimum of 8" above roof. The roof curb design shall allow field-fabricated rectangular supply/return ductwork to be connected directly to the curb. Curb design shall comply with NRCA requirements. Curb shall ship knocked down for field assembly and include wood nailer strips. Provide sloped curb as required for level unit installation.

### PART 3 EXECUTION

#### 3.1. INSTALLATION

- 1. Install power ventilators level and plumb.
- 2. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. At least one anchor shall be installed on each side of unit when attaching atop a curb.
- 3. In seismic zones, restrain support units.
- 4. Install units with clearances for service and maintenance.

5. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

**B. CONNECTIONS**

1. 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 "Duct Accessories."
2. Install ducts adjacent to power ventilators to allow service and maintenance.
3. Ground equipment.
4. 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.
5. Interlock operation of fans to associated backdraft and control dampers.

**C. FIELD QUALITY CONTROL**

1. Equipment Startup Checks:
  - a. Verify that shipping, blocking, and bracing are removed.
  - b. 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.
  - c. Verify that cleaning and adjusting are complete.
  - d. 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.
  - e. Verify lubrication for bearings and other moving parts.
  - f. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - g. Disable automatic temperature-control operators.
2. Starting Procedures:
  - a. Energize motor and adjust fan to indicated rpm.
  - b. Measure and record motor voltage and amperage.
3. 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.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Shut unit down and reconnect automatic temperature-control operators.
6. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
7. Replace fan and motor pulleys as required to achieve design airflow.
8. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

**D. ADJUSTING**

1. Adjust damper linkages for proper damper operation.
2. Lubricate bearings.

**E. CLEANING**

1. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
2. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

**F. DEMONSTRATION**

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Schedule training with Owner, through Architect, with at least seven days' advance notice.

**END OF SECTION 233400**

## SECTION 233713 – DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

### PART 2 - PRODUCTS

#### 2.1. GRILLES, REGISTERS AND DIFFUSERS

- A. Provide units by Titus, E.H. Price, Metal-Aire, Tuttle & Bailey, Krueger
- B. Provide product data for each type of product indicated, include the following: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings. Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- C. Submit information showing ceiling suspension assembly members, method of attaching hangers to building structure, size and location of initial access modules for acoustical tile. ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings. Duct access panels.
- D. Unless noted otherwise finish shall be off white when mounted in ceiling, prime coat when mounted on wall finish.
- E. All devices shall be provided with balancing means by either a damper in the takeoff to device or a damper that is part of the diffuser/grille assembly. All dampers shall be accessible to operate and balance.

### PART 3 EXECUTION

#### 3.1. GENERAL

- A. Provide where shown on plans grilles, registers, and diffusers. See drawings for types, sizes, air flow and quantity. Refer to schedule on plans.

#### 3.2. INSTALLATION

- A. Installation of diffusers, registers, and grilles shall meet the following requirements:
  - 1. Installed units shall be level and plumb.
  - 2. Set all units with rubber gaskets for air tight connection with mounting surface.
  - 3. Install all registers with curve of louver away from line of sight. Unless noted otherwise, provide duct mounted diffusers and registers with standard margins.
  - 4. For units installed in lay-in ceiling panels, locate units in the center of panel.
  - 5. For duct-mounted units, install with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

#### 3.3. COORDINATION

- A. Provide proper mounting supplies and arrangements for areas shown. Check Architectural drawings for ceiling and all construction.
- B. 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.
  - 1. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical.

3.4. BALANCING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 233713**

## SECTION 233750 – HVAC LOUVERS

### PART 1 GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. PERFORMANCE REQUIREMENTS

- A. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

#### 1.3. SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Product Test Reports: Based on tests performed according to AMCA 500-L.

### PART 2 PRODUCT

#### 2.1. LOUVERS

- A. Equivalent by Ruskin, Louvers and Dampers, Greenheck, American Warming and Ventilating, Industrial Louvers, ACME.
- B. Louvers shall be as scheduled on Drawings or Ruskin Model ELF375DXH extruded 6063T5 aluminum alloy construction as follows: 4" deep frame, 0.125" wall thickness. 0.125" wall thickness blades, Drainable blades are positioned at 37-1/2° angle and spaced approximately 53/32" center to center. Screen: 3/4" x .051" expanded, flattened aluminum in removable frame. Provide in custom Kynar finish as selected by Architect. AMCA Certified.
- C. Louvers shall be stationary drainable type with drain gutters in each blade and downspouts in jambs and mullions. Louvers shall have a minimum of 54% free area based on a 48" wide x 48" high size. Stationary drainable blades shall be contained within a 4" frame. Louver components (heads, jambs, sills, blades, & mullions) shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 10 feet and shall incorporate structural supports required to withstand a windload of 20 lbs. per sq. ft. (equivalent of a 90 mph wind).
- D. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- E. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- F. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- G. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.
- H. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

**END OF SECTION 233750**

## SECTION 238126 – SPLIT SYSTEM AIR HANDLERS AND CONDENSING UNITS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 230010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and scheduled.
- 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.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

### PART 2 PRODUCTS

#### 2.1. GENERAL

- A. Provide complete systems as scheduled on plans by one manufacturer.
- B. Equivalents by Carrier, Daikin Applied, JCI, Lennox.

#### 2.2. PRODUCTS

##### A. CONDENSING UNITS

1. Units shall be assembled on heavy gauge steel mounting/lifting rails and shall be weather proof. Units shall include a hermetic reciprocating compressor(s), plate fin condenser coil, fans and motors, controls and holding charge of R-22. Operating range shall be between 115 degrees F and 35 degrees F in cooling as standard from the factory. Units shall be UL 1995 listed, CAS CAN/CAS-C22.2 No. 236-M90, certified and rated in accordance with ARI Standard 210/240, 360 and 270.
2. CASING
  - a. Unit casing shall be constructed of 18 gauge zinc coated heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized and finished with a weather-resistant baked enamel finish. Units' surface shall be tested 500 hours in salt spray test. Units shall have removable end panels which allow access to all major components and controls.
3. REFRIGERATION SYSTEM - SINGLE COMPRESSOR
  - a. Units shall have a single refrigeration circuit. Each refrigeration circuit has an integral subcooling circuit. A refrigeration filter drier shall be provided as standard. The units shall have both a liquid line and suction gas line service valve with gauge port.
  - b. Units shall have one direct drive scroll compressor. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Crankcase heater, temperature and current-sensitive motor overloads shall be included for maximum protection. Shall have integral spring isolation and sound muffling to minimize vibration transmission and noise. External high and low pressure cutout devices shall be provided. Evaporator defrost control provided in indoor blower coil shall prevent compressor slugging by temporarily interrupting compressor operation when low evaporator coil temperatures are encountered.
4. CONDENSER COIL
  - a. Coils shall be internally finned or smooth bore 3/8" copper tubes mechanically bonded to configured aluminum plate fin as standard. Factory pressure and leak tested to 425 psig air pressure. Metal grilles with PVC coating for coil protection is optional.
5. CONDENSER FAN AND MOTOR(S)
  - a. Direct-drive, statically and dynamically balanced propeller fan(s) with aluminum blades and electro-coated steel hubs shall be used in draw-through vertical discharge position. Either permanently lubricated totally enclosed or open construction motors shall be provided and shall have built in current and thermal overload protection. Motor(s) shall have to be either ball or sleeve bearing type.
6. CONTROLS

- a. Condensing units shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Control wiring shall be 24-volt control circuit which includes fusing and control transformer. Units shall provide external location for mounting a fused disconnect device.
  7. ACCESSORIES
    - a. Time Delay Relay
      - i. Shall prevent compressors in dual compressor unit from coming on line simultaneously. Timer shall be 24-volt, 60 cycle, with four minute timing period.
  8. Anti-Short-Cycle Timer
    - a. Shall prevent rapid on-off conditions by not allowing compressor to operate for 5-7 minutes upon shutdown. Shall consist of a solid state timing device, 24 volt, 60 cycle with either 5 or 7 minute fixed-off timing period.
  9. Louvered hail guard for the condenser shall be provided to alleviate coil damage.
- B. AIR HANDLERS
1. UNITS
    - a. Air handler units shall be completely factory assembled including coil condensate drain pan, fan motor(s), filters and controls in an insulated casing that can be applied in either vertical or horizontal configuration. Units shall be rated and tested in accordance with ARI Standard 210, 240, 360. Units shall be UL listed and labeled in accordance with UL 465/1995 for indoor blower coil units. Air handler units shall be internally isolated to prevent sound transmission to building structure. Units shall be mounted on 4" high heavy gauge steel rails.
  2. CASING
    - a. Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized and finished with a weather-resistant baked enamel finish. Casing is completely insulated with fire-retardant, permanent, odorless glass fiber material. Knockouts shall be provided for unit electrical power and refrigerant piping connections. Captive screws shall be standard on all access panels.
  3. REFRIGERATION SYSTEM
    - a. A factory-installed thermal expansion valve controls each refrigeration circuit.
  4. EVAPORATOR COIL
    - a. Configured aluminum fin surface shall be mechanically bonded to 3/8" internally enhanced copper tubing and factory pressure and leak tested at 375 psig. Coil is arranged for draw-through airflow and shall provide condensate drain pan constructed of PVC plastic and provide external connections on either side of the unit.
  5. EVAPORATOR FAN
    - a. Double inlet, double width, forward curved, centrifugal-type fan(s) with adjustable belt drive shall be standard. Thermal overload protection shall be standard on motor. Fan and motor bearings shall be permanently lubricated.
  6. CONTROLS
    - a. Magnetic evaporator fan contactor, low voltage terminal strip, check valve(s), and single point power entry shall be included. All necessary controls shall be factory-installed and wired. Evaporator defrost control shall be included to prevent compressor slugging by temporarily interrupting compressor operation when low evaporator coil temperatures are encountered.
  7. FILTERS
    - a. Filters shall be Farr 30/30 type and shall have 2-inch thick fiberglass media contained in a rigid frame. Filters shall have a rigid supporting maze across both the entering and leaving faces of the media. Filters shall be sized so as not to exceed scheduled face velocities.
  8. ACCESSORIES
    - a. Evaporator Coils

- i. Shall be completely factory assembled including the expansion valves and drain pans. Single circuit condensing units shall be matched to single circuit coils and dual circuit condensing units to dual circuit coils. Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized and finished with an enamel finish. Casing shall be completely insulated with fire-retardant, permanent, odorless glass fiber material. The coils shall be convertible to either vertical and/or horizontal airflow configuration. Aluminum fin surface shall be mechanically bonded to 3/8" OD copper tubing. Coils shall be factory pressure and leak tested.
- b. Vibration Isolators
  - i. Shall reduce transmission of noise and vibration to building structures, equipment and adjacent spaces. Packages shall be available in either neoprene-in shear or spring-flex types in floor or suspended mountings.
- c. Provide 7-day electronic programmable thermostat for 1 or 2-stage heating and 1 or 2-stage cooling as scheduled on the plans.

### PART 3 EXECUTION

#### 3.1. AIR HANDLER INSTALLATION

- A. Suspended Units: Suspend from structure using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.
- B. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
- C. Controls: Install thermostats and humidistats at mounting height of 60 inches above floor.
- D. Identify according to Division 23 Section Mechanical Identification.
- E. Manufacturer to final size all refrigerant suction and liquid lines. Provide all accumulators, solenoid valve and any other components as required for refrigerant line lengths indicated by drawings. Provide all refrigerant and oil required for each refrigerant circuit.

#### 3.2. AIR HANDLER CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect condensate drain pans. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- C. Connect ducts according to Division 23 Section Ductwork.
- D. Install piping adjacent to machine to allow service and maintenance.
- E. Ground equipment according to Division 26 Section "Grounding"
- 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. Connect and wire any outside air dampers and interlock with unit operation. Install all electrical in accordance with Division 26. Provide all necessary relays, interlocks and circuiting to open outside air dampers during operation of unit fan.

#### 3.3. FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
- B. Perform the following field quality-control tests and inspections and prepare test reports:
  - 1. After installing units and after electrical circuitry has been energized, test units for compliance with requirements.
  - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 5. Remove malfunctioning units, replace with new units, and retest as specified above.

#### 3.4. STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
  - 1. Inspect for visible damage to unit casing.
  - 2. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
  - 3. Inspect internal insulation.

4. Verify that labels are clearly visible.
  5. Verify that clearances have been provided for servicing.
  6. Verify that controls are connected and operable.
  7. Verify that filters are installed.
  8. Clean outside coil and inspect for construction debris.
  9. Adjust vibration isolators.
  10. Lubricate bearings on fan.
  11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  12. Start unit according to manufacturer's written instructions.
  13. Complete startup sheets and attach copy with Contractor's startup report.
  14. Inspect and record performance of interlocks and protective devices; verify sequences.
  15. Operate unit for an initial period as recommended or required by manufacturer.
  16. Calibrate thermostats/sensors.
  17. Adjust and inspect high-temperature limits.
- C. Start refrigeration system and measure and record the following:
1. Coil leaving-air, dry- and wet-bulb temperatures.
  2. Coil entering-air, dry- and wet-bulb temperatures.
  3. Outside-air, dry-bulb temperature.
  4. Outside-air-coil, discharge-air, dry-bulb temperature.
- D. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
- E. Measure and record the following minimum and maximum airflows.
1. Supply-air volume.
  2. Return-air volume.
- F. Simulate maximum cooling demand and inspect the following:
1. Compressor refrigerant suction and hot-gas pressures.
- G. After startup and performance testing, change filters, vacuum cooling and outside coils, lubricate bearings.
- H. Provide one spare set of clean filters and deliver to owner.

### 3.5. AIR HANDLER ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set controls, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

### 3.6. AIR HANDLER CLEANING

- A. After completing installation, clean units internally according to manufacturer's written instructions.
- B. Install new filters in each unit within 14 days after Substantial Completion.

### 3.7. CONDENSING UNIT INSTALLATION

- A. Install condensing units according to manufacturer's written instructions.
- B. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.
- C. Install ground-mounted units on 4-inch-thick, reinforced concrete base, 4 inches larger than condensing unit on each side. Concrete, reinforcement, and formwork requirements are specified in Division 3. Coordinate installation of anchoring devices.
- D. Install roof-mounted units on equipment supports specified in Division 7. Anchor unit to supports with removable fasteners.
- E. Install units on spring isolators specified in Division 23 Section "Mechanical Vibration Controls and Seismic Restraints."

### 3.8. CONDENSING UNIT CONNECTIONS

- A. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.
- B. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories.
- C. Ground equipment.
- D. All exterior control wiring shall be installed in conduit.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

**3.9. CONDENSING UNIT FIELD QUALITY CONTROL**

- A. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.
- B. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units with new units and retest.

**3.10. CONDENSING UNIT CLEANING**

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Clean units to remove dirt and construction debris and repair damaged finishes.

**3.11. CONDENSING COMMISSIONING**

- A. Verify that units are installed and connected according to the Contract Documents.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
- C. Inspect for physical damage to unit casing.
- D. Verify that access doors move freely and are weathertight.
- E. Clean units and inspect for construction debris.
- F. Check that all bolts and screws are tight.
- G. Adjust vibration isolation and flexible connections.
- H. Verify that controls are connected and operational.
- I. Lubricate bearings on fans.
- J. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
- K. Adjust fan belts to proper alignment and tension.
- L. Start unit according to manufacturer's written instructions.
- M. Complete manufacturer's starting checklist.
- N. Measure and record airflow over coils.
- O. Check operation of condenser capacity control device.
- P. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.
- Q. After startup and performance test, lubricate bearings and adjust belt tension.

**3.12. CONDENSING UNIT DEMONSTRATION**

- A. Startup Services: Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
- B. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

**END OF SECTION 238126**

PKMR Engineers, LLC  
PKMR #22.113

Platte County, MO  
Platte Ridge Park

END OF DIVISION 230000

**DIVISION 26  
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## SECTION 260010 – ELECTRICAL PROVISIONS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. All contract documents including drawings, alternates, addenda and modifications and general provisions of the Contract, including General and Supplementary Conditions and all other Division Specification Sections, apply to work of this section. All preceding and following sections of this specification division are applicable to the Electrical Contractor, all sub-contractors, and all material suppliers.

#### 1.2. SCOPE OF WORK

- A. This DIVISION requires the furnishing and installing of complete functioning Electrical systems, and each element thereof, as specified or indicated on Drawings or reasonably inferred, including every article, device or accessory reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. In case of an inconsistency between the Drawings and Specifications or within either document, the better quality or the greater quantity of work shall be provided in accordance with the Architect or Engineer's interpretation.
- C. Refer to Architectural, Structural and Mechanical Drawings and all other contract documents and to relevant equipment drawings and shop drawings to determine the extent of clear spaces and make all offsets required to clear equipment, beams and other structural members to facilitate concealing conduit in the manner anticipated in the design.

#### 1.3. SPECIFICATION FORM AND DEFINITIONS

- A. The Engineer indicated in these specifications is Pearson Kent McKinley Raaf Engineers LLC. 13300 W 98th Street, Lenexa, KS 66215, PHONE 913-492-2400, EMAIL admin@pkmreng.com.
- B. Contractor, wherever used in these specifications, shall mean the Company that enters into contract with the Owner to perform this section of work.
- C. When a word, such as "proper", "satisfactory", "equivalent", and "as directed", is used, it requires the Architect-Engineer's review.
- D. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
- E. "INSTALL" means to join, unite, fasten, link, attach, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
- F. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
- G. "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
- H. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.
- I. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.
- J. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

#### 1.4. QUALIFICATIONS

- A. The contractors responsible for work under this section shall have completed a job of similar scope and magnitude within the last 3 years. The contractors shall employ an experienced, competent and adequate work force licensed in their specific trade and properly supervised at all times. Unlicensed workers and general laborers shall be adequately supervised to insure competent and quality work and workmanship required by this contract and all other regulations, codes and practices. At all times the contractors shall comply with all applicable local, state and federal guidelines, practices and regulations. Contractor may be required to submit a statement of qualifications upon request before any final approval and selection. Failure to be able to comply with these requirements is suitable reason for rejection of a bid.

#### 1.5. LOCAL CONDITIONS

- A. The contractor shall visit the site and determine the existing local conditions affecting the work required. Failure to determine site conditions or nature of existing or new construction will not be considered a basis for granting additional compensation.

#### 1.6. CONTRACT CHANGES

- A. Changes or deviations from the contract documents; including those for extra or additional work must be submitted in writing for review of Architect-Engineer. No verbal change orders will be recognized.

#### 1.7. LOCATIONS AND INTERFERENCES

- A. Locations of equipment, conduit and other electrical work are indicated diagrammatically by electrical drawings. Layout work from dimensions on Architectural and Structural Drawings. Verify equipment size from manufacturers shop drawings.
  - 1. Contractor shall be responsible for confirming adequate working space (depth, width, and height) is maintained about all equipment as required per applicable sections of the NEC, including all entrance and egress requirements.
  - 2. Coordinate with other trades to verify adequate Dedicated Equipment Space is maintained about all equipment as required per NEC.
- B. Study and become familiar with contract drawings of other trades and in particular general construction drawings and details in order to obtain necessary information for figuring installation. Cooperate with other workmen and install work in such a way to avoid interference with their Work. Minor deviations, not affecting design characteristics, performance or space limitation may be permitted if reviewed prior to installation by Architect-Engineer.
- C. Any conduit, apparatus, appliance or other electrical item interfering with proper placement of other work as indicated on drawings, specified, or required, shall be removed, relocated and reconnected without extra cost. Damage to other Work caused by this contractor, subcontractor, workers or any cause whatsoever, shall be restored as specified for new work.
- D. Do not scale electrical drawings for dimensions. Accurately layout work from dimensions indicated on Architectural drawings unless they are found to be in error.

#### 1.8. PERFORMANCE

- A. Final acceptance of work shall be subject to the condition that all systems, equipment, apparatus and appliances operate satisfactorily as designed and intended. Work shall include required adjustment of systems and control equipment installed under this specification division.
- B. The Contractor warrants to the Owner and Architect-Engineer the quality of materials, equipment, workmanship and operation of equipment provided under this specification division for a period of one year from and after completion of building and acceptance of mechanical systems by Owner.

#### 1.9. WARRANTY

- A. The Contractor warrants to the Owner and Architect-Engineer that upon notice from them within a one year warranty period following date of acceptance, that all defects that have appeared in materials and/or workmanship, will be promptly corrected to original condition required by contract documents at Contractor's expense.
- B. The above warranty shall not supersede any separately stated warranty or other requirements required by law or by these specifications.

#### 1.10. ALTERNATES

- A. Refer to General Requirements for descriptions of any alternates that may be included.

#### 1.11. MATERIALS, EQUIPMENT AND SUBSTITUTIONS

- A. The intent of these specifications is to allow ample opportunity for the Contractor to use their ingenuity and abilities to perform the work to their and the Owner's best advantage, and to permit maximum competition in bidding on standards of materials and equipment required.
- B. Material and equipment installed under this contract shall be first class quality, new, unused and without damage.
- C. In general, these specifications identify required materials and equipment by naming one or more manufacturer's brand, model, catalog number and/or other identification. The first named manufacturer or product is used as the basis for design; other manufacturers named must furnish products consistent with specifications of first named product as determined by Engineer. Base bid proposal shall be based only on materials and equipment by manufacturers named, except as hereinafter provided.
- D. Where materials or equipment are described but not named, provide required items of first quality, adequate in every respect for intended use. Such items shall be submitted to Architect-Engineer for review prior to procurement.
- E. Materials and equipment proposed for substitutions shall be equal to or superior to that specified in construction, efficiency, utility, aesthetic design, and color as determined by Architect-Engineer whose decision shall be final and without further recourse. Physical size of substitute brand shall be no larger than space provided including allowances for access for installation and maintenance. Requests must be accompanied by two copies of complete descriptive and technical data including manufacturer's name, model and catalog number, photographs or cuts, physical dimensions, operating characteristics and any other information needed for comparison.

- F. If the Contractor wishes to incorporate products other than those named in the Base Bid Specifications they shall submit a request for approval of equivalency in writing no later than (10) ten calendar days prior to bid date. Substitutions after this may be refused at Engineers option. Equivalents will ONLY be considered approved when listed by addendum.
  - 1. In proposing a substitution prior to or subsequent to receipt of bids, include in such bid the cost of altering other elements of this project, including adjustments in mechanical or electrical service requirements necessary to accommodate such substitution.
- G. Within 10 working days after bids are received, the apparent low bidder shall submit to the Architect-Engineer for approval, three copies of a list of all major items of equipment they intend to provide. Within 30 working days after award of Contract, Contractor shall submit shop drawings for equipment and materials to be incorporated in work, for Architect-Engineer review. Where 30-day limit is insufficient for preparation of detailed shop drawings on major equipment or assemblies, Contractor shall submit manufacturer's descriptive catalog data and indicate date such detailed shop drawings will be submitted along with manufacturer's certification that order was placed within 30 working day limit.

**1.12. ELECTRONIC PLAN FILES**

- A. Electronic files of the contract documents may be available from the Engineer to successful bidders and manufacturers for a fee of \$50 per sheet, \$100 minimum and \$25 email/shipping charge. A release of liability form will be required along with payment prior to release of files.

**1.13. OPENINGS, ACCESS PANELS AND SLEEVES**

- A. This Contractor shall include the installation of all boxes, access panels and sleeves for openings required to install this work, except structural openings incorporated in the structural drawings. Sleeves shall be installed for all conduits passing through structural slabs and walls. Contractor shall set and verify the location of sleeves that pass through beams, as shown on structural plans. All floor and wall penetrations shall be sealed to meet fire-rating requirements.
- B. All penetrations through interior or exterior and rated or non-rated walls and floors shall be appropriately sealed prevent entry and movement of rodents and insects. Contractor shall coordinate their work with all other trades.

**1.14. ARCHITECTURAL VERIFICATION AND RELATED DOCUMENTS**

- A. Contractor shall consult all Architectural Drawings and specifications in their entirety incorporating and certifying all millwork, furniture, and equipment rough-in including utility characteristics such as voltage, phase, amperage, pipe sizes, duct sizes, including height, location and orientation. Shop drawings incorporating these requirements should be submitted to the Architect for approval prior to installation or rough in.

**1.15. EXTENT OF CONTRACT WORK**

- A. Provide electrical systems indicated on drawings, specified or reasonably implied. Provide every device and accessory necessary for proper operation and completion of electrical systems. In no case will claims for "Extra Work" be allowed for work about which Electrical Contractor could have been informed before bids were taken.
- B. Where specific information for devices, lights or equipment shown on the plans is missing, provide an allowance in the contract amount for furnishing a product reasonably implied by the level of other devices, lights and equipment provided in the contract documents.
- C. Electrical Contractor shall be familiar with equipment provided by other Contractors that require electrical connections and control. Follow circuiting shown on drawings for lighting, power and equipment connections.
- D. Make required electrical connections to equipment provided under Architectural and Mechanical divisions of this project. Receive and install electric control devices requiring field installation, wiring, and service connection. Equipment supplied by the automatic temperature control contractor shall be installed by the mechanical or automatic temperature control subcontractor. Make required internal field wiring modifications indicated on wiring diagrams of factory installed control systems for control sequence specified. These field modifications shall be limited to jumper connections and connection of internal wiring to alternate terminal block lugs. The cost for field modifications requiring rewiring of factory installed control systems for equipment provided by General or Mechanical Contractors shall be included in base bid of the respective contractor. All temperature control wiring shall be by a licensed electrician under the supervision of temperature control contractor.
- E. Check electrical data and wiring diagrams received from Mechanical Contractor of compliance with project voltages, wiring, controls and protective devices shown on electrical drawings. Promptly bring discrepancies found to attention of Architect-Engineer for a decision.
- F. Provide safety disconnect switches, contactors, and manual and magnetic motor starters for mechanical and electrical equipment requiring such devices. Omit these devices where included as part of factory installed prewired control systems provided with mechanical equipment. With exception of factory installed devices, provide safety disconnect switches, contacts and motor starters by one manufacturer to allow maximum interchangeability of repair parts and accessories for these devices.
- G. To maximum extent possible electrical controls in boiler rooms, equipment rooms, and control rooms shall be

grouped in accessible locations and arranged according to function. Where possible use group control panels and combination starters in lieu of individually enclosed devices.

**1.16. CODES, ORDINANCES, RULES AND REGULATIONS**

- A. Provide work in accordance with applicable rules, codes, ordinances and regulations of Local, State, Federal Governments, and other authorities having lawful jurisdiction.
- B. Conform to latest editions and supplements of following codes, standards or recommended practices.
- C. BUILDING CODES:
  - 1. International Building Codes (Latest adopted version of applicable codes)
- D. SAFETY CODES:
  - 1. National Electrical Safety Code Handbook H30 - National Bureau of Standards
  - 2. Occupational Safety and Health Standard (OSHA) Department of Labor
- E. NATIONAL FIRE CODES AND STANDARDS:
  - 1. NFPA No. 70 National Electrical Code
  - 2. NFPA No. 90A Air Conditioning & Ventilation Systems
  - 3. NFPA No. 101 Life Safety Code
- F. UNDERWRITERS LABORATORIES INC.:
  - 1. All materials, equipment and component parts of equipment shall bear UL labels whenever such devices are listed by UL.
- G. MISCELLANEOUS CODES:
  - 1. ANSI A117.1 - Handicapped Accessibility
  - 2. Americans with Disabilities Act (ADA)
- H. ENERGY EFFICIENCY REQUIREMENTS:
  - 1. All electrical systems and components shall be manufactured and installed in compliance with ASHRAE 90.1 – 2007 and latest adopted version of IECC.

**1.17. STANDARDS**

- A. Drawings and specifications indicate minimum construction standard, should any work indicated be sub-standard to any ordinances, laws, codes, rules or regulations bearing on work, Contractor shall promptly notify Architect/Engineer in writing before proceeding with work so that necessary changes can be made. However, if Electrical Contractor proceeds with work knowing it to be contrary to any ordinances, laws, rules, and regulations he shall thereby have assumed full responsibility for and shall bear all costs required to correct non-complying work.

**1.18. PERMITS/FEES**

- A. Electrical Contractor shall secure and pay for necessary permits and certificates of inspection required by governmental ordinances, laws, rules or regulations. Keep a written record of all permits and inspection certificates and submit two copies to Architect/Engineer with request for final review.
- B. Contractor shall include in bid any charges by local utility providers to establish new services to the structure. Coordinate with the utility suppliers to verify exact which part of the work is to be performed by whom.

**PART 2 - PRODUCTS**

- A. Not Used

**PART 3 - EXECUTION**

**3.1. SUBMITTALS**

- A. Contractor shall furnish submittals of all materials and equipment required by the specifications. Refer to each specification section for the submittals (if any) required for that section.
- B. Submittal format shall be as indicated below. Submittals not meeting these requirements will be returned without action for re-submittal.
  - 1. Submittals shall be furnished in an Adobe PDF format.
  - 2. Submittals shall be per individual submittal section, as listed in the table of contents. All required submittals within that section shall be grouped together in a single submittal.

- a. Furnishing submittals by division or by individual item may result in delayed reviewing of the submittal(s) due to additional administrative time required to process the large size and/or quantity of files.
  3. Submittals shall have a cover page containing the following information: The project name, the applicable specification section and paragraph, the submittal date, and the Contractor's stamp (see below for requirements).
  4. Mark each submitted item as applicable with scheduled mark, name, etc. corresponding to the plans.
  5. Where generic catalog cuts are submitted for review, conspicuously mark or provide schedule of equipment, capacities, controls, fitting sizes, etc. that are to be provided. Each catalog sheet shall bear the equipment manufacturer's name and address.
  6. Where equipment submitted does not appear in base specifications or specified equivalent, mark submittals with applicable alternate numbers, change order number or letters of authorization.
  7. All submittals on materials and equipment listed by UL shall indicate UL approval on submittal.
- C. Contractor review:
1. Contractor shall check all submittals to verify that they meet specifications and/or drawings requirements before forwarding submittals to the Architect-Engineer for their review. All submittals submitted to Architect-Engineer shall bear contractor's approval stamp that shall indicate that Contractor has reviewed submittals and that they meet specification and/or drawing requirements. Contractor's submittal review shall specifically check for but not be limited to the following: equipment capacities, physical size in relation to space allowed; electrical characteristics, provisions for supply, return and drainage connections to building systems. All submittals not meeting Contractor's approval shall be returned to their supplier for re-submittal.
  2. No submittals will be considered for review by the Architect-Engineer without Contractor's approval stamp, or that have extensive changes made on the original submittal as a result of the Contractor's review.
  3. Before submitting shop drawings and material lists, verify that all equipment submitted is mutually compatible and suitable for the intended use. Verify that all equipment will fit the available space and allow ample room for maintenance. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- D. Review Schedule:
1. The shop drawing / submittal dates shall be at least as early as required to support the project schedule and shall also allow for two weeks Architect-Engineer review time plus a duplication of this time for re-submittal if required.
  2. Submittal of all shop drawings as soon as possible after permitting approval but before construction starts is preferred.
  3. Approval of shop drawings submitted prior to receipt of a permit for that respective scope of work should be considered conditional pending review/approval of the construction documents by the AHJ. Changes required to the submittal as a result of permitting comments received after architect's/engineer's review shall not be a justification for a change in price.
  4. Any time delay caused by correcting and re-submitting submittals/shop drawings will be the Contractor's responsibility.
- E. The Architect's-Engineer's checking and subsequent review of such drawings, schedules, literature, or illustrations shall not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless he has, in writing, called the Architect's-Engineer's attention to such deviations at the time of submission, and secured their written approval; nor shall it relieve the contractor from responsibility for errors in dimensions, details, size of members, or omissions of components for fittings; or for coordinating items with actual building conditions and adjacent work.
- F. Any corrections or modifications made by the Architect-Engineer shall be deemed acceptable to the Contractor at no change in price unless written notice is received by the Architect-Engineer prior to the performance of any work incorporating such corrections or modifications.
- G. Submittals that require re-submission shall have the items that were revised "flagged" or in some other manner marked to call attention to what has been changed.
- H. Coordination
1. After shop drawings have been reviewed and approved by all parties, transmit a set of submittals to each other trade (eg Plumbing, Mechanical, Electrical, Controls, etc) that will interface with installation. Each other contractor shall review the submittal for coordination and return a stamped submittal indicating they have reviewed the submittal for coordination purposes.

### 3.2. SHOP DRAWINGS

- A. Shop drawings shall meet all of the above requirements for submittals.

- B. Contractor shall submit Adobe PDF sets of all fabrication drawings. Cost of drawing preparation, printing and distribution shall be paid for by the contractor and included in his base bid.
- C. No work shall be fabricated until Architect-Engineer's review has been obtained.
- D. Electrical equipment location and conduit coordination shop drawings for conduit fabrication and electrical equipment clearances shall be a minimum of 1/4" scale. Shop drawings shall not be a reproduction of the contract document and shall show details of the following: Fabrication, assembly, and installation, including plans, elevations above finished floor, sections, components, and attachments to other work.

### 3.3. OPERATING AND MAINTENANCE INSTRUCTIONS (O & M MANUALS)

- A. Submit with shop drawings of equipment, three sets of operating and maintenance instructions and parts lists for all items of equipment provided. Instructions shall be prepared by equipment manufacturer.
- B. Keep in safe place, keys and wrenches furnished with equipment under this contract. Present to Owner and obtain receipt for same upon completion of project.
- C. Prepare a complete brochure, covering systems and equipment provided and installed under his contract. Submit brochures to Architect/Engineer for review before delivery to Owner. Contractor at his option may prepare this brochure or retain an individual to prepare it for him. Include cost of this service in bid. Brochures shall contain following:
  - 1. Certified equipment drawings/or catalog data with equipment provided clearly marked as outlined under Section this specification.
  - 2. Complete installation, operating, maintenance instructions and parts lists for each item of equipment.
  - 3. Record copy of all submittals indicating actual equipment installed indicating options, characteristics. Copies of submittals shall bear the stamps of all parties that reviewed submittals.
  - 4. Special emergency operating instructions with a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to various parts of system.
  - 5. Record Set Drawings: The Contractor shall mark up a set of contract documents during construction noting all changes and deviations including change orders. These will be delivered to Architect at end of the project. After the originals are changed to reflect the blue line set, a copy shall be included in the brochure.
  - 6. Provide brochure bound in black vinyl three-ring binders with metal hinge. Reinforce binding edge of each sheet of loose-leaf type brochure to prevent tearing from continued usage. Clearly print on label insert of each brochure:
    - a. Project name and address.
    - b. Section of work covered by brochure, i.e., Electrical.

### 3.4. RECORD DOCUMENTS

- A. During construction, keep an accurate record of all deviations between the work as shown on Drawings and that which is actually installed. Keep this record set of prints at the job site for review by the Architect/Engineer.
- B. Upon completion of the installation and acceptance by the owner, transfer all record drawing information to one neat and legible set of prints. Then deliver them to the Architect/Engineer for transmittal to the Owner.
- C. Provide one copy of on high quality heavy weight presentation type paper. Blueprints or other media which fade shall not be used.
- D. Provide one electronic scanned version of record documents in Adobe PDF format – PDFs may be submitted on electronic media (DVD, USB) or via an FTP or other file sharing site. Provide electronic copies in conjunction with hard copy documents.

### 3.5. PREMIUM TIME WORK

- A. The following Work shall be performed at night or weekend other than holiday weekends as directed and coordinated with the Owner.
  - 1. All tie-in, cut-over and modifications to the existing electrical system and other existing system requiring tie-ins or modifications shall be arranged and scheduled with the Owner to be done at a time as to maintain continuity of the service and not interfere with normal building operations.

### 3.6. CLEANING UP

- A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
- B. Contractor shall clean up all fixtures and equipment at the completion of the project.
- C. All switchboards, panelboards, wireways, trench ducts, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

### 3.7. WATERPROOFING

- A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
- B. If Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense

### 3.8. CUTTING AND PATCHING

- A. Contractor shall do cutting and patching of building materials required for installation of work herein specified. Remove walls, ceilings and floors (or portions thereof) necessary to accomplish scope of work. Do not cut or drill through structural members including wall, floors, roofs, and supporting structure, without the Architect's and Structural Engineer's approval and in a manner approved by them.
- B. Make openings in concrete with concrete hole saw or concrete drill. Use of star drill or air hammer for this work will not be permitted.
- C. Patching shall be by the contractors of the particular trade involved, shall match the existing construction type, quality, finish and texture, and shall meet approval of Architect-Engineer. Damage to building finishes, caused by installation of electrical work shall be repaired at Contractor's expense to approval of Architect-Engineer.

### 3.9. SETTING, ADJUSTMENT AND EQUIPMENT SUPPORTS

- A. Work shall include mounting, alignment and adjustment of systems and equipment. Set equipment level on adequate foundations and provide proper anchor bolts and isolation as shown or specified. Level, shim, and grout equipment bases as recommended by manufacturer. Mount motors, align and adjust drive shafts and belts according to manufacturer's instruction. Equipment failures resulting from improper installation or field alignment shall be repaired or replaced by Contractor at no cost to Owner.
- B. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
- C. Provide electrical floor mounted equipment with 3-1/2" high concrete bases unless shown or specified otherwise. Electrical contractor shall size all pads. General contractor shall form all pads, provide and place all concrete for said pads. Individual concrete pad shall be no less than 4" wider and 4" longer than equipment, and shall extend no less than 2" from each side of equipment.
- D. Provide each piece of equipment or apparatus suspended from ceiling or mounted above floor level with suitable structural support, platform or carrier in accordance with best recognized practice. Electrical contractor shall arrange for attachment to building structure, unless otherwise indicated on drawings or as specified. Provide hangers with vibration eliminators where required. Contractor shall verify that structural members of building are adequate to support equipment. Submit details of hangers, platforms and supports together with total weights of mounted equipment to Architect/Engineer for review before proceeding with fabrication or installation.
- E. Provide 3-1/2" high concrete housekeeping pad as specified above where two or more conduits penetrate floor below panelboards.

### 3.10. START-UP, CHANGEOVER, TRAINING AND OPERATION CHECK

- A. Electrical Contractor shall be responsible for training Owner's operating personnel to operate and maintain systems and equipment installed. Keep a record of training provided to Owner's personnel listing the date, subject covered, instructor's name, names of Owner's personnel attending and total hours of instruction given each individual.
- B. All owner-training sessions shall be orderly and well organized and shall be video recorded digitally. At the end of the owner training, the "training" session recording shall be transmitted to the owner via DVD and shall become property of the owner.

### 3.11. FINAL CONSTRUCTION REVIEW

- A. At final construction review, Electrical Contractor and the major sub-contractors shall be present or shall be represented by a person of authority. Each Contractor shall demonstrate, as directed by Architect/Engineer, that the work complies with purpose and intent of plans and specifications. Respective Contractor shall provide labor, services, instruments or tools necessary for such demonstrations and tests.

**END OF SECTION 260010**

## SECTION 260011 – BASIC ELECTRICAL MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### PART 2 - PRODUCTS

Not Used

### PART 3 - EXECUTION

#### 3.1. NEUTRAL AND GROUND WIRES

- A. Where individual circuit homeruns (hots, neutral, and ground as part of a single circuit) are indicated on the plans serving lighting and branch circuit receptacle loads, these shall be individual circuits with individual neutrals (no sharing of neutrals and/or grounds).
- B. Where shared circuit homeruns (hots, neutral, and ground as part of separate circuits) are indicated on the plans, these shall be allowed to share one (common) ground for three (3) circuits from different phases occurring in one (1) conduit run. When additional circuits occur in conduit run, additional ground wires shall be installed. Conduit shall be upsized and conductors shall be de-rated based on NEC current carrying conductor tables, counting all hots and neutrals as current carrying conductors.
  - 1. No sharing of neutral conductors is allowed in multi-wire branch circuit homeruns, unless the installation meets the requirements of 2014 NEC 210.4(B), and is specifically approved by the engineer of record.

#### 3.2. TESTS RECORDING, REPORTING TESTS AND DATA

- A. Record nameplate horsepower, amperes, volts, phase service factor and other necessary data on motors and other electrical equipment furnished and/or connected under this contract.
- B. Record motor starter catalog number, size and rating and/or catalog number of thermal-overload units installed in all motor starters furnished and/or connected under this contract. See motor starter specification for instructions for proper sizing of thermal-overload units.
- C. Record amperes-per-phase at normal or near-normal loading of each item of equipment furnished and/or connected.
- D. Record correct readings of each feeder conductor after energized and normally loaded, and again after balancing of feeder loads as required by current readings.
- E. Record voltage and ampere-per-phase readings taken at service entrance equipment after completion of project with building operating at normal electrical load.
- F. Short-Circuit Calculations
  - 1. Contractor shall contact utility company after utility company design is complete and determine exact available fault current in amperes at the point of utility connection (Service Point).
  - 2. Contractor shall utilize the above available fault current to calculate the available fault current in amperes (RMS-SYM) at the service equipment.
  - 3. The available fault current shall be labeled on the service equipment – refer to Section 260553.
- G. Submit at least two (2) typewritten copies of data noted above to Architect-Engineer for review prior to final inspection.
- H. Keep a record of all deviations made from routes, locations, circuiting, etc. shown on contract drawings. Prior to final inspection submit one new set of project drawings with all deviations and changes clearly indicated.

#### 3.3. CLEANING AND PAINTING OF MATERIALS AND EQUIPMENT

- A. Before energizing switchboards, transformers, panelboards, starters, variable frequency drive and other similar electrical equipment, Contractor shall thoroughly vacuum out all dirt, dust and debris from inside of equipment and shall thoroughly clean outside and inside of equipment.
- B. Touch-up painting and refinishing of factory applied finishes shall be by Electrical Contractor. Contractor shall be responsible for obtaining proper type of painting materials and color from equipment manufacturer.
- C. Unless specified otherwise factory built equipment shall be factory painted. Paint shall be applied over surfaces only after they have been properly cleaned and coated with a corrosion resistant primer.
- D. After installation, damage to painted surfaces shall be properly prepared and primed with primers equal to factory materials. Finish coating shall be same color and type as factory finish.
- E. Where extensive refinishing is required equipment shall be completely repainted.

#### 3.4. EXCAVATION AND BACKFILL

- A. Perform necessary excavation to receive work. Provide necessary sheathing, shoring, cribbing, tarpaulins, etc. for this operation, and remove at completion of work. Perform excavation in accordance with appropriate section of these specifications, and in compliance with OSHA Safety Standards.
- B. Excavate trenches of sufficient width to allow ample working space, and no deeper than necessary for installation work.
- C. Conduct excavations so no walls or footings are disturbed or injured.
- D. Backfill excavations made under or adjacent to footing with selected earth or sand and tamp to compaction required by A/E.
- E. Mechanically tamp backfill under concrete and pavings in 6" layers to 95% standard density, Reference Division 2.
- F. Backfill trenches and excavations to required heights with allowance made for settlement.
- G. Tamp fill material thoroughly and moistened as required for specified compaction density.
- H. Dispose of excess earth, rubble and debris as directed by Architect.
- I. When available, refer to test hole information on architectural drawings or specifications for types of soil to be encountered in excavations.

#### 3.5. TEMPORARY COVERINGS

- A. Provide temporary covering over all electrical panels, distribution panelboards, outlet boxes and other equipment as required to keep same free from damage due to moisture, plaster, paint, concrete or other foreign materials. Any equipment with finish damaged by moisture, paint, plaster or other foreign materials shall be cleaned and refinished as directed by the Architect without additional cost to the Owner.
- B. All temporary openings in conduits shall be covered with metal or plastic caps.

#### 3.6. PROTECTIVE COVERS

- A. Provide protective wire guards over all wall mounted and ceiling mounted devices subject to damage in areas such as gymnasiums, shops and similar occupancies.
- B. Provide lockable covers over thermostats and similar wall mounted devices where items are located in public spaces but should not be operable by the general public.

#### 3.7. SLEEVES

- A. Provide proper type and size sleeves to General Contractor for electrical ducts, busses, conduits, etc. passing through building construction. Supervise installation to insure proper sleeve location. Unless indicated or approved install no sleeves in structural members.
- B. Provide cast iron sleeves extending 1 inch above finished floor where sleeves pass through floors subject to flooding such as toilet rooms, bathrooms, equipment rooms and kitchen. Seal opening between pipe and sleeve with Thunderline Corp. Link Seal.
- C. Unless specified otherwise provide 18 gauge galvanized sheet metal sleeves through floors and non-bearing walls. Where piping passes through exterior walls, equipment room walls, air plenum walls and walls between areas that must be isolated from occupied areas, seal space between sleeves and piping, air or water tight are required with Thunderline Corp. Link Seal.
- D. Provide O-Z Electrical Manufacturing Co., Inc. Type "FSK" or "WSK" or equivalent thruwall and floor seals where conduits pass through concrete foundation walls below grade.
- E. Provide Zurn Z-195 or equivalent flashing sleeve through walls and floors with waterproof membrane. Seal annular space between conduit and sleeve with Thunderline Link Seal or O-Z type CSM sealing bushing.

**END OF SECTION 260011**

## SECTION 260013 – PROJECT COORDINATION

### 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 administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Administrative and supervisory personnel.
  - 3. Project meetings.
  - 4. Requests for Interpretation (RFIs).
  - 5. Wiring of equipment furnished by others
- B. Each related sub-contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

#### 1.3. COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Delivery and processing of submittals.
  - 2. Progress meetings.
  - 3. Preinstallation conferences.
  - 4. Project closeout activities.
  - 5. Startup and adjustment of systems.

#### 1.4. SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
  - 1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
    - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate required installation sequences.
    - c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches. Format shall be PDF or other electronic format to facilitate multiple user commenting and sharing easily.
  3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including project managers, superintendent and other personnel in attendance at Project site to the General Contractor and other major subcontractors. Identify individuals and their duties and responsibilities; list email addresses and telephone numbers. Update the list as required during the project if personnel change.

#### 1.5. COORDINATION

- A. Certain materials will be provided by other trades. Examine the Contract Documents and reviewed record Submittals to ascertain these general requirements. Contract Documents reflect a basis of design and may not reflect actual equipment or items being utilized.
- B. Carefully check space requirements with other trades and the physical confines of the area to insure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
- C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
- D. Wherever work interconnects with work of other trades, coordinate with other trades to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
- E. Obtain equipment submittal information for all pieces of equipment to be connected to from other trades that clearly indicates all connection requirements, locations, sizes, and similar requirements. Obtain this information in ample time to coordinate other trade submittals and equipment coordination. Where requirements differ from that on plans or differs from provisions made in the work, immediately notify the Architect/Engineer. Do not proceed with work that is incompatible with equipment provided.
- F. Coordinate, project and schedule work with other trades in accordance with the construction sequence.
- G. Coordinate with the local Utility Companies to their requirements for service connections and provide all necessary materials, labor and testing.
- H. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.
- I. Conduct a coordination meeting after reviewing all other trade coordination drawings with other relevant trades. This meeting shall be held to prevent conflicts during construction. Each major relevant subcontractor shall attend this meeting. Report any potential conflicts or clearance problems to Architect/Engineer after meeting.
- J. Adjust location of piping, ductwork, conduit, wiring, etc. to prevent interferences, both anticipated and encountered. Determine the exact route and location of each item prior to fabrication.

##### 1. Right-of-Way:

- a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
- b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.

#### 1.6. DRAWINGS AND FILES.

- A. The Drawings show only the general run of MEP systems, equipment, fixtures, piping and ductwork and other components as well as approximate location of items such as outlets, switches, diffusers, lights, and equipment connections, etc. Coordinate all exact locations of items with other trades, architectural elevations, equipment requirements, owner requirements, ceilings, access, serviceability, etc. All such modifications and coordination shall be made without additional cost to the Owner. Any significant changes in location of items necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made
- B. Wherever the work is of sufficient complexity, additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field. Attend meetings with other trades to review all documents.
- C. When directed by the General Contractor for areas of necessary coordination provide 3D building modelling coordination files and documents with other trades. Transmit information electronically and attend meetings as directed by the G/C as well as take part in coordination activities and documentation. Contractor shall be required to generate their own electronic files for this process.

### 1.7. PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
  - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Possible conflicts.
    - i. Compatibility problems.
    - j. Time schedules.
    - k. Manufacturer's written recommendations.
    - l. Warranty requirements.
    - m. Compatibility of materials.
    - n. Space and access limitations.
    - o. Regulations of authorities having jurisdiction.
    - p. Testing and inspecting requirements.
    - q. Installation procedures.
    - r. Coordination with other work.
    - s. Required performance results.
    - t. Protection of adjacent work.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- C. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  - 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contractor is on time, ahead or behind schedule, in relation to Construction Schedule. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Discuss impact of various contractor schedules upon other contractors and how to remedy impacts.
    - b. Review present and future needs of each contractor present, including the following:
      - i. Interface requirements.

- ii. Sequence of operations.
- iii. Status of submittals.
- iv. Deliveries.
- v. Off-site fabrication.
- vi. Access.
- vii. Quality and work standards.
- viii. Change Orders.

- 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

#### 1.8. REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI.
  - 1. Submit Contractor's suggested solution(s) to RFI. If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  - 2. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

#### PART 2 PRODUCTS (Not Used)

#### PART 3 EXECUTION (Not Used)

##### 3.1. EQUIPMENT FURNISHED BY OTHERS

- A. Description:
  - 1. Items furnished by other trades (mechanical or plumbing contractor, etc.) such as mechanical/plumbing equipment, line voltage actuators, VFDs (not by electrical contractor), etc.
  - 2. Kitchen equipment (may be furnished by owner, owner's vendor, or separate sub-contractor)
  - 3. Equipment furnished by general contractor
  - 4. Equipment furnished by owner
- B. General
  - 1. Fully review manufacturer's installation instructions for equipment. Installation of all related electrical items noted below shall be per same.
    - a. Electrical contractor shall obtain same from others if not readily available.
- C. Disconnecting Means
  - 1. An approved disconnecting means shall be provided at all equipment and shall serve to disconnect power from same.
  - 2. Disconnecting means may be a switch, circuit breaker, or a cord-and-plug type connection.
  - 3. Disconnecting means shall be within sight of equipment, as defined by NEC.
  - 4. Disconnect switches may be non-fused, unless specifically shown fused on the plans or otherwise required by code to be fused.
    - a. All disconnect switches serving elevator equipment shall be provided with an overcurrent protective device.
- D. Wiring of Equipment
  - 1. Wire sizes used shall be as directed on plans or installation instructions, whichever is greater. Contractor shall notify engineer of any deviations from wire sizes listed on construction documents.
  - 2. Wiring shall include a neutral conductor where shown on plans or required by installation instructions.
    - a. If a neutral conductor is shown on the plans but not required by installation instructions, verify removal of neutral wire with engineer via RFI prior to proceeding.
  - 3. Wiring of elevators and other such equipment shall account for voltage drop limitations of equipment.

**END OF SECTION 260013**

## SECTION 260519 – WIRE AND CABLE

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

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

#### 1.2. SUMMARY

- A. This Section includes the following:
1. Building wires and cables rated 600 V and less.
  2. Connectors, splices, and terminations rated 600 V and less.

#### 1.3. SUBMITTALS

- A. Product Data: For each type of product indicated.  
B. Qualification Data: For testing agency.  
C. Field quality-control test reports.

#### 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. Comply with NFPA 70.

#### 1.5. COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

### PART 2 - PRODUCTS

#### 2.1. CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Southwire Company.
  2. General Cable Corporation.
  3. Encore Wire Corporation.
  4. AFC Cable Systems, Inc. (Multiconductor cable only)
- B. Copper Conductors: Comply with NEMA WC 70.  
C. Aluminum Conductors: Comply with NEMA WC 70.
- a. Same shall be compacted aluminum (Stabiloy)
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN-2.
1. Provide consistent color coding of all circuits as follows:

Phase	Distribution System	
	120/208	277/480
<b>A</b>	Black	Brown
<b>B</b>	Red	Orange
<b>C</b>	Blue	Yellow
<b>N</b>	White	Gray
<b>Ground</b>	Green	Green w/ Stripe <sup>1</sup>

Notes:

- 1) Stripe shall be white or yellow in color.

- E. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

#### 2.2. CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cable manufacturers listed above under 2.1, Item A.
  2. Hubbell Power Systems, Inc.
  3. O-Z/Gedney; EGS Electrical Group LLC.

4. 3M; Electrical Products Division.
  5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### PART 3 - EXECUTION

#### 3.1. CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
1. Aluminum conductors acceptable only when specifically shown/scheduled on drawings.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
1. Aluminum conductors are not permitted for branch circuit wiring.

#### 3.2. CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Provide insulation / cable types for conductors as follows:

Application	Insulation / Cable Type		
	THHN/THWN-2 <sup>1</sup>	XHHW-2 <sup>1</sup>	MC Cable <sup>3</sup>
Service Entrance	X <sup>2</sup>	X	
Feeders:			
Exposed, Exterior	X <sup>2</sup>	X	
Exposed, Interior	X		
Concealed in Ceilings, Walls, Partitions, and Crawlspace	X		
Concealed in Concrete, below Slabs-on-Grade, and Underground	X <sup>2</sup>	X	
Branch Circuits:			
Exposed, Exterior	X <sup>2</sup>	X	
Exposed, Interior - Including Crawlspace	X		
Concealed in Ceilings, Walls, and Partitions	X		X
Concealed in Concrete, below Slabs-on-Grade, and Underground	X <sup>2</sup>	X	

#### Notes:

- 1) Single conductors in raceway. Refer to Section 260533 - Raceway & Boxes for acceptable raceway types/applications.
  - 2) THHN/THWN-2 is acceptable for these installations at contractor's discretion.
  - 3) Metal Clad (MC) cable installations shall be in accordance with the following:
    - (i) MC cable shall not be used for homeruns.
    - (ii) MC cable may be used for light fixture and equipment whips in lengths no longer than 6'-0". The use of MC cable from lighting fixture to lighting fixture shall not be allowed.
    - (iii) MC cable shall not be installed in exposed locations for lighting purposes. MC cable may be exposed in mechanical spaces for equipment whips.
- B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- C. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.
- D. Class 2 Control Circuits: Type THHN-THWN-2, in raceway or Power-limited cable, concealed in building finishes.

#### 3.3. INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

- E. Support cables per National Electrical Code requirements.
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

#### 3.4. CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

#### 3.5. FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Remove and replace malfunctioning units and retest as specified above.

**END OF SECTION 260519**

## SECTION 260526 – GROUNDING

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Reference Section 260519 for general requirements of all conductors.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. DESCRIPTION OF WORK

- A. Provide grounding electrodes, conductors, connections and equipment to provide a solidly grounded electrical system.

#### 1.3. STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
  - 1. Underwriters Laboratory Standard No. U.L. 467.
  - 2. ANSI C-1 1978.
  - 3. IEEE Standards No. 142-1982, 1100-1992 and No. 80.
  - 4. National Electrical Safety Code.
  - 5. NFPA.

#### 1.4. SUBMITTALS

- A. For each type of product data listed.
- B. Submit test reports certifying resistance values for buried or driven grounds and water pipe grounds.

### PART 2 - PRODUCTS

#### 2.1. CONDUCTORS

- A. Grounding conductor sizes shall be as shown on plans or if not specifically shown shall be no smaller than that required by the NEC.
- B. Insulated Conductors: Annealed tinned copper wire. Size as indicated on Drawings; insulation to conform with requirements of Section 260519.
- C. Bare Copper Conductors:
  - 1. Stranded Conductors: ASTM B 8.
  - 2. Tinned Conductors: ASTM B 33.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4" by 2" in cross section, unless otherwise indicated; with insulators.

#### 2.2. GROUNDING ELECTRODES

- A. Ground Rods:
  - 1. Copper-clad steel fabricated by molten welding process.
  - 2. Diameter: 5/8 Inch. Use 3/4" for rocky soil.
  - 3. Length: 8 feet.

#### 2.3. CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

### PART 3 - EXECUTION

#### 3.1. APPLICATIONS

- A. General:

1. Where metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts are indicated to serve as grounding conductors, same shall be effectively bonded where necessary to assure electrical continuity and the capacity to safely conduct and fault current likely to be imposed on them.
  - a. Any non-conductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings so designed as to make such removal unnecessary.
- B. Underground Grounding Conductors: Install bare tinned copper conductor, #2/0 AWG minimum.
  1. Bury at least 24" below grade.
- C. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Bolted or Welded connectors.
  3. Connections to Structural Steel: Bolted or Welded connectors.
- D. Grounding Bus: Install in electrical service rooms, data rooms, and elsewhere as indicated.
  1. Install bus on insulated spacers a minimum of 1" from wall and 6" above finished floor, unless otherwise indicated.

### 3.2. EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
  1. Provide low voltage distribution system with a separate green insulated equipment grounding conductor for each single or three-phase feeder.
  2. Branch circuits shall consist of phase and neutral conductors as shown/indicated and a green ground conductor installed in common raceway which shall serve as the equipment grounding conductor.
    - a. Equipment grounding conductors for branch circuit home runs shown on the drawings shall indicate an individual and separate ground conductor for that homerun which shall be terminated at the branch circuit panelboard, switchboard, or other distribution equipment. No sharing of equipment grounding conductors sized according to the size of the overcurrent device and NEC Table 250-122 shall be allowed.
  3. Where ground cable is installed in metallic conduit, bond cable to conduit at both ends.
  4. Connect ground conductors in cables and in conduit to appropriate ground buses (as in switchgear, motor control centers, and distribution panelboards) or directly to metallic enclosure if no ground bus is provided.
  5. Required equipment grounding conductors and straps shall be sized in compliance with N.E.C. Table 250-122.
  6. Equipment grounding conductors shall be provided with green type TW 600 volt insulation. Related feeder and branch circuit grounding conductors shall be connected to ground bus with approved pressure connectors.
  7. Provide feeder servicing several panelboards with a continuous grounding conductor connected to each related panelboard ground bus. Installation shall include necessary precautions regarding terminations with dissimilar metals.
  8. Where parallel feeders are installed in more than one raceway, each raceway shall have a green insulated equipment grounding conductor.
- B. Separately Derived Systems
  1. Equipment grounding conductors shall be provided for separately derived systems and shall be grounded to building steel, cold water pipes, etc., or an alternate grounding means.
- C. Conduit Attachment to Electrical Equipment:
  1. Ground conduits to metal framework of electrical equipment with double locknuts or grounding bushings and bonding jumpers unless otherwise noted.
  2. Install bonding jumpers at all electrical equipment to provide continuous ground return path through conduit.
  3. Install bonding jumpers across expansion fittings between conduit sections for ground path continuity.
  4. Provide grounding type bushings for conduits terminated through multiple concentric knockouts not fully knocked out, on inside of electrical enclosures. Install bonding jumper between ground bushing and enclosure.
- D. Receptacles:

1. Install bonding jumpers between outlet box and receptacle grounding terminal except where contact device or yoke is provided for grounding purposes.
- E. Switches
  1. Where required, provide grounding clip on each toggle switch. Mount over device mounting strap such that contact is made between mounting strap, screw, faceplate and outlet box.
  2. Provide devices with ground screw and bond to switch box.
- F. Wireways:
  1. Install grounding jumpers for bonding between wireway and other panelboards, conduit, switchgear, motor control centers, and at any other point where solid connection would otherwise not provided in supporting system to insure continuous ground.
- G. Pull Boxes, Junction Boxes and Enclosures:
  1. Connect all equipment grounding conductors together and connect to the box.
- H. Coordination with Other Trades:
  1. Where low-voltage cabling for tele/data, security systems, A/V systems, etc. is not otherwise part of the scope of work indicated herein, electrical contractor shall coordinate required grounding/bonding of these components with the owner's vendor or other subcontractor.
  2. Each system of continuous metallic piping and ductwork shall be grounding in accordance with the requirements of the National Electrical Code.
    - a. Portions of these systems which are isolated by flexible connections, insulated couplings, etc. shall be bonded to the equipment ground with a flexible bonding jumper.
  3. Mechanical equipment shall be bonded to the building equipment grounding system. This shall include, but not be limited to: fans, pumps, chillers, etc.

### 3.3. GROUNDING ELECTRODE SYSTEM

- A. General:
  1. The system neutral shall be grounded at the service entrance only and kept isolated for grounding systems throughout the building.
  2. The grounding electrode system shall include all of the following grounding methods at minimum, where available:
    - a. The metal frame of the building, where effectively grounded.
    - b. A metal underground water piping system used for grounding shall be in direct contact with the earth for ten feet or more and shall be electrically continuous. Provide bonding jumpers at water meter and at insulated joints.
    - c. Steel reinforcing bars used for grounding shall be encased by at least two inches of concrete, located within and near the bottom of a concrete foundation or footing that is in direct contact with the earth. Reinforcing bars shall be minimum 1/2 inch diameter and consisting of twenty feet of one or more steel reinforcing bars.
    - d. All bonding jumpers for the above grounding systems shall be sized in accordance with National Electrical Code.
- B. Service Ground
  1. Connect system neutral ground and equipment ground system to common ground bus.
  2. Ground secondary services at supply side of each individual secondary disconnecting means and at related transformers in accordance with National Electrical Code.
  3. Provide each service disconnect enclosure with neutral disconnecting means which interconnects with insulated neutral and uninsulated equipment ground sub to establish system common ground point.
  4. Neutral disconnecting links shall be located so that low voltage neutral bar with interior secondary neutrals can be isolated from common ground bus and service entrance conductors.

### 3.4. INSTALLATION

- A. Grounding Electrode Conductors: route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2" below finished floor or final grade, unless otherwise indicated.
  1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating (if any).

- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Make connections with clamp type fitting; do not damage water pipe.
  - 3. Bond ground conductor and its conduit to water pipe.
- E. Ufer Ground (Concrete-encased grounding electrode):
  - 1. Fabricate according to NFPA 70.
  - 2. If concrete foundation is less than required length, coil excess conductor within base of foundation.
  - 3. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

### 3.5. FIELD QUALITY CONTROL

- A. Resistance Values for System and Equipment Grounds: for each ground rod and ground grid.
  - 1. Acceptable Testing Equipment: Vibroground by Associated Research, Inc.; or Megger Earth Tester by James G. Biddle Co.
  - 2. Method: Three (3) electrode fall of potential as prescribed by instrument manufacturer.
  - 3. Drive additional ground rods spaced eight feet apart, if necessary, until total resistance of system is measured at five ohms or less.

**END OF SECTION 260526**

## SECTION 260529 – HANGERS & SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

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

#### 1.2. SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

#### 1.3. DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### 1.4. PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.5. QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

#### 1.6. COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

### PART 2 PRODUCTS

#### 2.1. SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - i. Hilti Inc.
      - ii. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - iii. MKT Fastening, LLC.
      - iv. Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - i. Cooper B-Line, Inc.; a division of Cooper Industries.
      - ii. Empire Tool and Manufacturing Co., Inc.
      - iii. Hilti Inc.
      - iv. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - v. MKT Fastening, LLC.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 6. Toggle Bolts: All-steel springhead type.
  - 7. Hanger Rods: Threaded steel.

## 2.2. FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 EXECUTION

### 3.1. APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Support raceways at intervals no greater than ten (10) feet and with one support within three (3) feet of each coupling, box, fitting, or outlet box. Provide one support within three (3) feet of each elbow or bend.
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 20 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- F. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- G. Use one or two-hole saddle-type clamps where single conduits are exposed below 6'-0" AFF.

### 3.2. SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel:
    - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts
    - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
    - c. Spring-tension clamps].
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3. INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4. CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03."
- C. Anchor equipment to concrete base.
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

**END OF SECTION 260529**

## SECTION 260533 – RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. DESCRIPTION OF WORK

- A. Provide complete raceways systems, boxes and fittings for all required electrical systems.

#### 1.3. STANDARDS

- A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:
  - 1. Rigid Steel Conduit
    - a. U.L. Standard UL-6
    - b. A.N.S.I. C80-1
    - c. Federal Specification WW-C-581E
  - 2. Intermediate Metallic Conduit
    - a. U.L. Standard UL-1242
    - b. Federal Specification WW-C-581E
  - 3. Electrical Metallic Tubing
    - a. U.L. Standard UL-797
    - b. A.N.S.I. C80-3
    - c. Federal Specification WW-C-563
  - 4. Flexible Steel Conduit
    - a. U.L. Standard UL-1
  - 5. Liquid Tight Flexible Conduit
    - a. U.L. Standard UL-360
  - 6. Non-Metallic Conduit
    - a. U.L. Standard UL-651
    - b. A.N.S.I. Standard F512
    - c. N.E.M.A. Standard TC-2
    - d. Federal Specifications GSA-FSS and W-C-1094-A
  - 7. Wireways and Auxiliary Gutters
    - a. U.L. Standard UL-870
  - 8. Rigid Aluminum Conduit
    - a. A.N.S.I. C80.5

#### 1.4. SUBMITTALS

- A. Provide manufacturer's catalog cuts of fittings.
- B. Where wireways and/or auxiliary gutters are employed full erection drawings must be submitted. Drawings to include plan views, elevations, size of wireways, type and quantity of conductors proposed to be installed therein, etc.
- C. Indicate duct banks or multi-trade coordinated shop drawings.
- D. Submit shop drawings or catalog descriptive data on boxes exceeding twenty-four (24") inches for any one dimension.
- E. Submit shop drawings or catalog descriptive for floor boxes and accessories.

### PART 2 - PRODUCTS

#### 2.1. RACEWAY TYPES

- A. Standard Threaded Rigid Steel Conduit.

1. Rigid conduit heavy wall galvanized.
  2. Threaded type fittings: "Erickson" couplings where threaded cannot be used.
- B. Intermediate Metallic Conduit
1. Light weight rigid steel conduit.
  2. Threaded type fittings: "Erickson" couplings where threaded cannot be used.
- C. Electrical Metallic Tubing
1. Continuous, seamless tubing, galvanized or sheradized on the exterior, coated on the interior with a smooth hard finish of lacquer, varnish, or enamel.
  2. Couplings and connectors:
    - a. Indoor and two (2") inches in size and smaller, shall be steel set-screw type fittings.
    - b. 2-1/2 inch size and larger must employ steel compression gland fittings.
    - c. Outdoor shall be raintight steel compression gland fittings.
  3. Indent type fittings shall not be used.
  4. All connectors shall have insulated throat.
  5. Where installed in slab or concrete work, provide approved concrete tight fittings.
- D. Flexible Steel Conduit
1. Single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel.
  2. Maximum length: (six 6) feet.
  3. Each section of raceway must contain an equipment grounding wire bonded at each end and sized as required. Provide connectors with insulating bushings.
  4. Steel squeeze-type or steel set screw type fittings.
- E. Liquid Tight Flexible Electrical Conduit
1. Same as flexible steel conduit except with tough, insert water-tight plastic outer jacket.
  2. Cast malleable iron body and gland nut, cadmium plated with one-piece brass grounding bushings which thread to interior of conduit. Spiral molded vinyl sealing ring between gland nut and bushing and nylon insulated throat.
- F. Non-Metallic Raceway
1. Composed of polyvinyl chloride suitable for 90 degrees C. Provide rigid polyvinyl chloride (PVC) type EPC 40 heavy wall plastic conduit meeting current NEMA Standard TC-2. Conduit shall be listed UL 651 for underground and exposed use.
  2. Raceway, fittings, and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years experience in manufacturing the products.
  3. Materials must have a tensile strength of 7,000-7,200 psi at 73.4 degrees F., flexural strength of 12,000 psi and compressive strength of 9,000 psi.
  4. All joints shall be solvent cemented in accordance with the recommendations of the manufacturer.
- G. Wireways and Auxiliary Gutters
1. Painted steel or galvanized steel.
  2. Of sizes and shapes indicated on the Drawings and as required.
  3. Provide all necessary elbows, tees, connectors, adapters, etc.
  4. Wire retainers not less than twelve (12") inches on center.
- H. Aluminum Conduit
1. Do not use aluminum conduit unless specifically indicated on the drawings for special purposes.

## 2.2. LOCKNUTS AND BUSHINGS

- A. Locknuts shall be steel. Die cast locknuts shall not be used.
- B. All bushings shall be insulated. Use nylon insulated metallic bushings for sizes 1" and larger. Plastic bushings may be used in 1/2" and 3/4" sizes.

## 2.3. OUTLET BOXES

- A. General
1. Recessed wall boxes shall be 2-1/2" deep.
  2. Surface-mounted wall boxes shall be 1-1/2" or 2-1/2" deep as required.
  3. Lighting Fixture Box

- a. Four (4") inch octagon with 3/8" fixture stud.
  - b. For suspended ceiling work, four (4") inch octagon with removable backplate where required, and two (2) parallel bars for securing to the cross-furring channels and extend flexible conduit to each fixture.
4. Plug any open knockouts not utilized.
- B. Cast Type Conduit Boxes, Outlet Bodies and Fittings
  1. Use Ferrous Alloy boxes and conduit bodies with Rigid Steel or IMC.
  2. Use Ferrous Alloy or cast aluminum boxes and conduit bodies with Electrical Metallic Tubing.
  3. Covers: Cast or sheet metal unless otherwise required.
  4. Tapered threads for hubs.
- C. Masonry Outlet Boxes
  1. Use for all devices recessed in concrete or masonry.
  2. Galvanized steel construction.
- D. Drawn Steel Boxes
  1. Use for all interior exposed devices (where not required or indicated to be cast type).
  2. Drawn construction, minimum 0.025" thick galvanized steel.
  3. Raised ground connection.
  4. Provide with raised, drawn galvanized steel covers.
- E. Welded Steel Boxes
  1. May be used for recessed devices only, or as a junction box where located above ceiling or on walls where same is located above 6'-0" A.F.F.
  2. Minimum 1/16" thick steel construction.
- F. Weatherproof Boxes
  1. Use for all exterior exposed devices.
  2. Cast aluminum construction.
  3. Internal hub threads.
  4. NEMA 3R listed.

#### 2.4. JUNCTION AND PULL BOXES

- A. Outlet boxes as listed above may be used as junction boxes where provided as a 2-gang box minimum.
- B. Steel Boxes
  1. No. 12 USS gauge sheet steel for boxes with maximum side less than forty (40") inches, and maximum area not exceeding 1,000 square inches; riveted or welded 3/4 inch flanges at exterior corners.
  2. No. 10 USS gauge sheet steel for boxes with maximum side forty (40") to sixty (60") inches, and maximum area 1,000 to 1,500 square inches; riveted or welded 3/4 inch flanges at exterior corners.
  3. No. 10 USS gauge sheet steel riveted or welded to 1-1/2 by 1-1/2 by 1/4" welded angle iron framework for boxes with a maximum side exceeding sixty (60") inches and more than 1,500 square inches in area.
  4. Covers
    - a. Same gauge steel as box.
    - b. Subdivided single covers so no section of cover exceeds fifty (50) pounds.
    - c. Machine bolts, machine screws threaded into tapped holes, or sheet metal screws as required; maximum spacing twelve (12") inches.
  5. Finish: Galvanized steel or paint with rust inhibiting primer and ANSI No. 61 light gray finish coat.
  6. Where size of box is not indicated, size to permit pulling, racking and splicing of cables.
  7. For Boxes over 600 Volts
    - a. Provide insulated cable supports and removable steel barriers to isolate each feeder. Stencil cable voltage class in red letters on the front cover of the box.
    - b. Braze a ground connector suitable for copper cables to the inside of the box.
- C. Exterior Pull / Junction boxes
  1. NEMA 3R or 4X rated.
  2. Stainless steel or reinforced non-metallic construction.
- D. In-Grade Pull Boxes (Quazite or similar)
  1. Polymer concrete box. Removable cover with stainless steel bolts.

2. Box shall be traffic-rated where located in pavement or other areas subject to vehicle traffic.

### PART 3 - EXECUTION

#### 3.1. APPLICATION OF RACEWAYS

- A. The following applications must be adhered to except as otherwise required by Code. Raceways not conforming to this listing must be removed by the Contractor and replaced with the specified material at the Contractor's expense.
  1. Rigid Steel - Application: Where exposed to mechanical injury, where specifically required, exterior exposed locations, and where required by codes and for all circuits in excess of 600 volts.
  2. I.M.C. - Application: Same as standard threaded rigid steel conduit.
  3. E.M.T. - Applications: Use in every instance except where another material is specified. EMT shall not be used underground or in slab on grade.
  4. Flexible Steel - Applications: Use in dry areas for connections to lighting fixtures in hung ceilings, connections to equipment installed in removable panels of hung ceilings at bus duct takeoffs, at all transformer or equipment raceway connections where sound and vibration isolation is required.
  5. Liquid-Tight Flexible Conduit - Applications: Use in areas subject to moisture where flexible steel is unacceptable at connections to all motors, and all raised floor areas.
  6. Non-Metallic Conduit - Application: Schedule 40 - Where specifically indicated on the drawings and for raceways in slab or below grade. All bends shall be made with steel elbows and wrapped unless the bend is encased in concrete.
  7. Wireways and Auxiliary Gutters - Application: Where indicated on the Drawings and as otherwise specifically approved.

#### 3.2. RACEWAY SYSTEMS IN GENERAL

- A. Provide raceways for all wiring systems, including security, data transmission, paging, low voltage et. al. Where non-metallic raceways are utilized, provide sizes as required with the grounding conductor considered as an insulated additional conductor. Wiring of each type and system must be kept independent and installed in separate raceways – including, but not limited to:
  1. Wiring of different voltages (480/277V vs. 208/120V)
  2. Emergency / Normal Wiring (except as permitted by NEC 700)
- B. Install capped bushings on raceways as soon as installed and remove only when wires are pulled. Securely tie embedded raceway in place prior to embedment. Lay out the work in advance to avoid excessive concentrations of multiple raceway runs.
- C. Locate raceways so that the strength of structural members is unaffected and they do not conflict with the services of other trades. Install one (1") inch or larger raceways, in or through structural members (beams, slabs, etc.) only when and in the manner accepted by the Architect/Engineer. Draw up couplings and fittings full and tight.
- D. Install no conduits or other raceways sized smaller than permitted in applicable NEC Tables. Where conduit sizes shown on drawings are smaller than permitted by code, Contractor shall include cost for proper size conduit in his base bid. In no case reduce conduit sizes indicated on drawings or specified without written approval of Architect-Engineer. Minimum conduit size shall be 3/4".
- E. Above-grade raceways to comply with the following:
  1. Install raceways concealed except at surface cabinets and for motor and equipment connection in electrical and mechanical rooms. Install a minimum of six (6") inches from flues, steam pipes, or other heated lines. Provide flashing and counter-flashing for waterproofing of raceways, outlets, fittings, etc., which penetrate the roof. Route exposed raceways parallel or perpendicular to building lines with right-angle turns and symmetrical bends. Run concealed raceways in a direct line and, where possible, with long sweep bends and offsets. Provide sleeves in forms for new concrete walls, floor slabs, and partitions for passage of raceways. Waterproof sleeved raceways where required.
  2. Raceways shall not be run on roofs or exposed on the outside of the buildings unless specifically noted as exposed on the drawings or approved by the Architect/Engineer.
  3. Provide raceway expansion joints for exposed and concealed raceways with necessary bonding conductor at building expansion joints and between buildings or structures and where required to compensate for raceway or building thermal expansion and contraction. Provide expansion fittings every 200 feet on outdoor conduit.
  4. Provide one (1) empty 3/4 inch raceway for each three (3) spare unused poles or spaces of each flush-mounted panelboard. Terminate empty 3/4 inch conduit in a junction box, which after completion, is accessible to facilitate future branch circuit extension.
  5. Provide raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.) in special occupancy area, as required. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceiling, or floors which separate adjacent rooms having substantially different

- maintained temperatures, as in refrigeration or cold storage rooms.
6. Provide pull string in spare or empty raceways. Allow five (5) feet of slack at each end and in each pull box. Tie each end of the string to a washer or equivalent that does not fit into the conduit. Tag both ends of string denoting opposite end termination location.
- F. Below Grade
1. Below grade raceways to comply to the following:
    - a. Do not penetrate waterproof membranes unless proper seal is provided.
  2. Protect steel raceway in earth or fill with two (2) coats of asphalt base paint. Touch up abrasions and wrench marks after conduit is in place.
  3. In lieu of the above, protect steel raceways with a minimum of ten (10) mil tape approved for the purpose and overlapped a minimum of one-half tape width to provide a minimum twenty (20) mil thickness.
- G. No raceway may be installed in a concrete slab or members except with the permission of the Structural Engineer and with the written consent of the Owner.
1. Conduits embedded in structural concrete slabs shall have an outside diameter less than one third of the thickness of the concrete slab and shall be installed entirely within the center one third of the concrete slab.
  2. Raceways embedded in concrete slabs shall be spaced not less than eight (8") inches on centers and as widely spaced as possible where they converge at panels or junction boxes.
  3. In no case will installation of raceways be permitted to interfere with the proper placement of principal reinforcement.
  4. Raceways running parallel to slab supports, such as beams, columns, and structural walls, shall be installed not less than twelve (12") inches from such supporting elements.
  5. To prevent displacement during concrete pour of lift slab, saddle supports for conduit, outlet boxes, junction boxes, inserts, etc., shall be secured with suitable adhesives.
- H. Non-metallic raceway installation shall conform to the following:
1. All joints are to be made by the solvent cementing method using the material recommended by the raceway manufacturer. To insure good joints, components shall be cleaned prior to assembly.
  2. Raceway cut-offs shall be square and made by handsaw or other approved means which does not deform the conduit. Raceway shall be reamed prior to solvent cementing to couplings, adapters, or fittings.
  3. Electrical devices which are served by PVC raceways shall be grounded by means of a ground wire pulled in the raceway.
  4. Bends shall be made by methods that do not deform or damage the conduit. The radii of field bends shall not be less than those established by the N.E.C.
  5. Raceway expansion fittings shall be provided where necessary. The position of the expansion fitting shall be adjusted proportional to the temperature at installation.
  6. Raceway supports shall be installed, in such a manner, to allow the PVC conduit to slide through the supports as the temperature changes.
  7. Elbows must be galvanized rigid steel, intermediate metallic conduit or concrete encased. Plastic conduit may only be used for exterior underground applications or circuits beneath slabs on grade. Provide galvanized rigid steel (GRS) radius bends and risers as conduits rise above grade or above floor slab.
  8. Provide exterior underground conduit with metal detection strip.
  9. Provide matching plastic fittings. Fittings shall meet the same standards and specifications as the conduit on which it is installed.
  10. Joining and bending of conduit and installation of fittings shall be done only by methods recommended.
  11. Provide conduit support spacing as recommended for the highest ambient temperature expected.
  12. Provide interlocking conduit spacers for multiple runs of underground conduits installed in same trench.
  13. Provide expansion couplings on long runs regardless of ambient temperatures. Determine amount of conduit expansion and contraction from published charts or tables.
  14. Test workmanship by conducting a low-pressure air (3.0-5.0 psi) test after system is installed and cemented joints are set. Plug and block ends to prevent movement prior to pressurization. Check for leaks at all joints with a soap solution. Even low-pressure air can cause high thrust loads and caution must be observed. The test shall be observed by the architect, engineer or owner's representative, prior to backfill. All below grade conduit that could potentially drain water into electrical equipment (ie. Main electrical service located in basement below utility transformer) must be watertight.
- I. Raceways in hung ceiling shall be run on and secured to slab or primary structural members of ceiling, not to lathing channels or T-bars, Z-bars, or other elements which are the direct supports of the ceiling panels. Secure conduit firmly to steel by clips and fittings designed for that purpose. Install as high as possible, but not less than 1'-0" above hung ceilings.

- J. Exposed raceways shall be run parallel or at right angles with building lines.
- K. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. This shall be done with ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt, or similar material. This assembly may be pulled in together with, but ahead of, the cable being installed. All empty raceways shall be similarly cleaned. Clear any raceway which rejects ball mandrel.

### 3.3. OUTLET BOXES

- A. Fit outlet boxes in finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide Series "GW" (Steel City) tile box, or as accepted, or a four (4") inch square box with tile ring in masonry walls, which will not be plastered or furred. Where drywall material is utilized, provide plaster ring.
  - 1. Provide outlet boxes of the type and size suitable for the specific application.
  - 2. Where outlet boxes contain two (2) or more 277 volt devices, or where devices occur of different applied voltages, or where normal and emergency devices occur in same box, provide suitable barrier.
  - 3. Install all wall mounted switch and receptacle boxes with bracing between two adjacent studs where rigid conduit is not used for circuiting. Box and receptacle shall not deflect on operation or insertion of plugs.
- B. Install boxes and covers for wiring devices so that the wiring devices will be installed with a vertical orientation unless otherwise noted on the drawings.
- C. The exact location of outlets and equipment is governed by structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels equipment, etc., with Architect.
- D. Back-to-back outlets in the same wall, or "thru-wall" type boxes not permitted. Provide twelve (12") inch (minimum) spacing for outlets shown on opposite sides of a common wall to minimize sound transmission.
- E. Install top of switch outlet boxes 48" above floor unless otherwise called for or required by wainscot, counter, etc. Install bottom of receptacle outlet boxes 16" above floor unless otherwise called for on drawings.
  - 1. Adjust mounting heights to nearest masonry joint for minimum cutting in case of flush outlets.

### 3.4. JUNCTION AND PULL BOXES

- A. Provide junction and pull boxes as indicated on the drawings and as required for the complete installation of the various electrical systems, and to facilitate proper pulling of wires and cables.
  - 1. J-boxes and pull boxes shall be sized per electrical code minimum.
  - 2. Boxes on empty conduit systems shall be sized as if containing conductors of #4 AWG.
  - 3. Wiring systems required to have separate/independent raceways (See Section 3.2 above) shall also be provided with separate junction and pull boxes. These wiring systems may occupy the same outlet box only if a divider is installed between the wiring that is listed for this purpose.
- B. Pull Box Spacing
  - 1. Provide pull boxes so no individual conduit run contains more than the equivalent of four (4) quarter bends (360 degrees total).
  - 2. Conduit Sizes 1-1/4" and Larger.
    - a. Provide boxes to prevent cable or wire from being excessively twisted, stretched, or flexed during installation.
    - b. Provide boxes for medium voltage cables so that maximum pulling tensions do not exceed cable manufacturer's recommendations.
    - c. Provide support racks for boxes with multiple sets of conductors do not rest on any metal work inside box.
  - 3. Conduit Sizes one (1") inch and smaller, low voltage wire and cable (maximum distances)
    - a. 200 feet straight runs.
    - b. 150 feet runs with one 90 degree bend or equivalent.
    - c. 125 feet runs with two 90 degree bends or equivalent.
    - d. 100 feet runs with three or four 90 degree bends or equivalent.

**END OF SECTION 260533**

## SECTION 260553 – ELECTRICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. DESCRIPTION OF WORK

- A. Provide identification on all equipment, raceways, boxes and conductors.

### PART 2 - PRODUCTS

#### 2.1. NAMEPLATES

- A. Nameplates shall be lamacoid plates with engraved upper-case letters and beveled edges.
  - 1. Stamped or embossed metal tags are not considered acceptable for this purpose.
- B. Color:
  - 1. Normal-power equipment shall have white nameplates with black letters, enclosed by a black border.
  - 2. Equipment fed from the emergency electrical system, or otherwise designated on the plans for emergency use, shall have red nameplates with white letters, enclosed by a white border.
  - 3. Nameplates for short circuit ratings and calculations shall be yellow with black letters, enclosed by black border.
- C. All nameplates shall be engraved and must be secured with rivets, brass or cadmium plate screws. The use of Dymo tape or the like is unacceptable.
- D. Nameplate inscriptions shall bear the name and number of equipment to which they are attached as indicated on the Drawings. The engineer reserves the right to make modifications in the inscriptions as necessary.
  - 1. Inscription letters shall be 1/2" in size.

#### 2.2. CABLE TAGS AND WIRE IDENTIFICATION LABELS

- A. Cable tags shall be flameproof secured with nylon ties.
- B. Wire markers shall be preprinted cloth tape type or approved equivalent.

#### 2.3. IDENTIFICATION LABELS

- A. Acceptable Manufacturers
  - 1. W.H. Brady Company (Style A)
  - 2. Thomas & Betts Company (T&B), Style A.
  - 3. Seaton
- B. Plasticized Cloth
  - 1. Non-conductive.
  - 2. Waterproof.
  - 3. Capable of withstanding continuous temperatures of 235 degrees F and intermittent temperatures to 300 degrees F.
  - 4. Overcoating for protection against oil, solvents, chemicals, moisture, abrasion and dirt.
- C. Heavy, thermo-resistant industrial grade adhesive, for adhesion of label to any surface without curling, peeling or falling off.
- D. Label Designations, Nominal System Voltages Applied to the covers of all medium and low voltage pull, splice and junction boxes.
- E. Machine printed.
  - 1. Letters shall be 3/8" in size.

### PART 3 - EXECUTION

#### 3.1. INSTALLATION

- A. Service Entrance Equipment
  - 1. Where electrical equipment (switchboard, panelboard, disconnect switch, etc.) is installed as service

entrance equipment, contractor shall furnish and install a nameplate listing the following:

- a. Equipment Short-Circuit Current Rating in amperes (RMS SYM), as indicated on the drawings.
- b. Whether or not the equipment is fully or series-rated.
- c. Available Fault Current in amperes. Contractor shall perform available fault current calculation (as outlined in Section 260011) to obtain available fault at Service Equipment.
- d. Date fault current calculations were performed.
- i. Example:

EQUIPMENT FULLY-RATED AT 65,000 AMPERES RMS SYM  
AVAILABLE FAULT CURRENT: 45,203 AMPERES  
DATE CALCULATED: 2/24/2022

2. Contractor shall furnish and install another nameplate (in addition to above) at *each* service overcurrent protective device listing the following per NEC Article 110:

- a. Service Disconnect #
- b. Nominal system voltage
- c. Available Fault Current in amperes (see item 'c' above).
- d. Clearing time of service overcurrent protective device based on the aforementioned fault current
- e. Date the label was applied.
- i. Example:

SERVICE DISCONNECT 1 of 4  
NOMINAL SYSTEM VOLTAGE: 208V  
AVAILABLE FAULT CURRENT: 45,203 AMPERES  
CLEARING TIME OF THIS DEVICE: 0.3S  
DATE CALCULATED: 2/24/2022

B. Switchboards/ Distribution Panelboards.

1. Furnish and install a nameplate for each switchboard or distribution panelboard. Nameplate shall be engraved with the following information:

- a. Top Line: Equipment identification as indicated on the Drawings.
- b. Middle Line: Specific device or equipment where feeder originates.
- c. Bottom Line: Equipment voltage, size, and phase as indicated on the drawings.
- d. Example:

SWITCHBOARD SWDP1  
FED FROM UTILITY COMPANY TRANSFORMER  
208/120V, 1200A, 3-PHASE

2. Nameplate shall be mounted at the top of the incoming section.
3. Each switch / circuit breaker shall be provided with an identifying nameplate.
  - a. Main devices shall be identified as such. Where multiple mains are employed each switch shall be numbered. Inscription shall be "MAIN SWITCH" or "MAIN SWITCH NO. 1" et al.
  - b. Branch/feeder devices shall be identified with either the load served or a number corresponding to the furnished circuit directory.

C. Panelboards and Load Centers.

1. Furnish and install a nameplate for each panelboard and load center. Nameplate shall be engraved with the following information:
  - a. Top Line: Equipment identification as indicated on the Drawings.
  - b. Middle Line: Specific device or equipment where feeder originates.
  - c. Bottom Line: Equipment voltage, size, and phase as indicated on the drawings.
  - d. Example:

PANELBOARD LN1  
FED FROM SWITCHBOARD SWDP1 IN ROOM #332  
208/120V, 200A, 3-PHASE

2. Nameplate shall be mounted at the top of the panel.
  3. After installations are complete, provide and mount under sturdy transparent shield in the directory frame of each panel door, a neat, accurate, and carefully typed directory properly identifying the lighting, receptacles, outlets, and equipment each overcurrent device controls.
    - a. Include on directory the panel or load center identification, the cable and raceway size of panel feeder, and the feeder origination point.
- D. Disconnect Switches.
1. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves and the panel and circuit the switch is fed from.
- E. Disconnect Switches.
1. Furnish and install a nameplate for each disconnect switch engraved with the equipment designation which the disconnect serves.
    - a. Example:

AHU – 1  
FED FROM PANEL LP-1 – 32
  2. Nameplate shall be mounted at the top of the disconnect.
- F. Motor Controllers.
1. Furnish and install a nameplate for each motor controller or combination motor controller for both individual motor controllers and those in a motor control center. Engraving must indicate the motor served and the type of service (e.g., AC-8-1st floor supply, EF-2 electric closet exhaust.)
- G. Feeder Switches.
1. Furnish and install for each feeder switch including, but not limited to those in switchboards, switch and fuse panelboards, take-offs at bus ducts, motor control centers, multiple meter centers, etc., two (2) nameplates as follows:
    - a. The first nameplate must be white background with red lettering. Engrave with the words "REPLACE ONLY WITH \_\_\_\_\_ FUSE." Engrave with proper fuse trade name and ampere rating (i.e. Bussman LPS-R 100).
    - b. The second nameplate shall indicate the load served, the size and type of cable and raceway example:
      - i. LP-4, LP-5, LP-6
      - ii. 4#500 KCMILS-THW-CU-3-1/2"C
- H. Switches.
1. Furnish and install an engraved nameplate for each switch, controlling loads that are not local to the switch. Engraving shall be as directed by the Engineer.
- I. Receptacles.
1. Furnish and install a clear typed label on each faceplate for each receptacle indicating panel and circuit.
    - a. Example:

LP-1/32
  2. Label shall be mounted at the top of the faceplate.
- J. Pullboxes, Enclosures, and Cable Terminations.
1. Circuits rated over 40 Amp and all cables over 600V:
    - a. Provide identification label with circuit numbers on enclosure cover.

- b. Furnish and install cable tags on each cable that enters a pullbox, enclosure, switchboard, and at terminations. Mark tags with type written inscription noting the load served, type and size of cable, and the overcurrent device protecting the cable.

K. Branch circuits:

1. Provide identification label with panel and circuit numbers on enclosure cover.
2. Identify each circuit with wire markers when enclosure label and wire colors do not provide enough information to identify each circuit without tracing.
3. Provide feeders and branch circuit home runs with plasticized wire marker indicating circuit number and power source. Provide feeders phase identification letter at each terminal point in addition to its circuit number.
4. 4 square box covers hidden above lay-in ceilings may be marked with indelible ink marker in lieu of using printed labels.

L. Telecommunications System.

1. Each horizontal cable from a termination block or patch panel to a telecommunications outlet shall be labeled at both ends. Tags shall be consecutively numbered so that no two (2) cables have the same identification. In addition cable tag shall note the room number in which the data transmission outlet is located.
2. Each backbone cable shall have a flameproof tag attached at both ends of the tag. Tags shall be consecutively numbered so that no two (2) cables have the same identification. Additional inscriptions shall be provided as directed by the Owner.
3. Patch panel ports shall be consecutively numbered so that no two (2) ports have the same number.
4. Furnish and install a clear typed label on each faceplate for each outlet and jack indicating cable per ANSI/TIA/EIA/606A standards and project nomenclature. Label materials and finish shall match style, font, color, etc as any adjacent receptacles.
5. Label shall be mounted at the top of the faceplate.

M. Warning Signs

1. Provide electrical equipment and accessible wiring enclosures operating at voltage above 240 volts with self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1-1964 and OSHA 19.0.144iii(2) Specifications "Danger High Voltage" warning sign and voltage marker applied to front door or cover of device or enclosure.
2. Provide large equipment such as transformers and main distribution equipment with self-sticking polyester sign with wording and size conforming to ANSI Standard Z35.1-1964 and OSHA 19.0.144iii(2) Specifications indicating all electrical characteristics.

N. Boxes

1. Provide identification labels for all low voltage and medium voltage pull, splice and junction boxes in main feeder and subfeeder runs, indicating nominal system voltage.
2. Apply labels after painting of boxes, conduits, and surrounding areas have been completed.
3. Clean surfaces before applying labels; clean aluminum surfaces with solvent wipe.
4. Apply labels on cover and minimum of one (1) fixed side; one (1) label visible from floor where boxes are installed exposed.

**END OF SECTION 260553**

## SECTION 260923 – LIGHTING CONTROL DEVICES

### PART 1 GENERAL

#### 1.1. SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. Outdoor photoelectric switches.
3. Indoor occupancy sensors.
4. Lighting contactors.
5. Emergency shunt relay.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of product indicated.  
B. Field quality-control test reports.  
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.

### PART 2 PRODUCTS

#### 2.1. TIME SWITCHES

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

1. GE
2. Intermatic, Inc.
3. Leviton.
4. Lithonia Lighting.
5. Paragon Electric Co.
6. Square D.
7. TORK.
8. Watt Stopper.

B. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Five subparagraphs below describe optional features.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Astronomic dial in first subparagraph below makes the time switch self-adjusting for seasonal changes and automatically adjusts on-off times as days grow shorter or longer.
6. Astronomic time dial.
7. Eight-Day Program: Uniquely programmable for each weekday and holidays.
8. Skip-a-day mode.
9. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

#### 2.2. OUTDOOR PHOTOELECTRIC SWITCHES

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

1. GE
2. Intermatic, Inc.
3. Leviton.
4. Lithonia Lighting.
5. Paragon Electric Co.
6. Square D.
7. TORK.
8. Watt Stopper.

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.

2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

### 2.3. INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper (Greengate)
  2. Hubbell Lighting.
  3. Leviton Mfg. Company Inc.
  4. Philips Controls
  5. Sensor Switch, Inc.
  6. Steinel
  7. Watt Stopper.
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

### 2.4. LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
  2. GE.
  3. Hubbell Lighting.
  4. Square D.
  5. TORK.
  6. Watt Stopper.
- B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  3. Enclosure: Comply with NEMA 250.
  4. Provide with control and pilot devices as scheduled, matching the NEMA type specified for the enclosure. Provide with accessory module for 2-wire control as necessary for control.

5. The contactor shall have provisions for factory or field addition of:

- a. Four (4) N.O. or N.C. auxiliary contacts rated 6 amperes continuous at 600 volts.
- b. Single or double circuit, N.O. or N.C., 30 or 60 ampere 600 volt power-pole adder.
- c. Control-circuit fuse holder, one or two fuses.
- d. 0.2-60 second TDE or TDD timer attachment.
- e. Transient-suppression module for control circuit of 120 volts.

**2.5. EMERGENCY SHUNT RELAY**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Lighting Control and Design, Inc.

- B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 or 277 V as required.

**PART 3 EXECUTION**

**3.1. SENSOR INSTALLATION**

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

**3.2. CONTACTOR INSTALLATION**

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

**3.3. IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
1. Identify controlled circuits in lighting contactors.
  2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

**3.4. FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

**END OF SECTION 260923**

## SECTION 262416 – PANELBOARDS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
- C. Field quality-control reports.
- D. Operation and maintenance data.

#### 1.3. QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

#### 1.4. WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1. GENERAL

- A. Provide panelboards as indicated in the panelboard schedule and where shown on the plans. Panelboards shall be equipped with fusible switches or thermal-magnetic, molded case circuit breakers as indicated on the schedules.

#### 2.2. MANUFACTURERS

- A. Equivalents by Eaton (Cutler-Hammer), Square D, GE, or ITE Siemens.
  - 1. Equivalent Panelboards to those specified on the plans shall be considered as follows:

Cutler Hammer	Square D	GE	Siemens
Pow-R-Line 1A	NQOD	AQ	P1
Pow-R-Line 2A	NQOD	AE	P2
Pow-R-Line 3A	NF* / I-Line	AE* / Spectra	P3
Pow-R-Line 4B	I-Line	Spectra	P4

\* Submitted equipment must be able to accommodate ALL breakers shown in panelboard schedules as branch-mounted devices. If unable to do so, provide distribution panelboard as noted.

### 2.3. PANELBOARDS

#### A. Bussing Assembly and Temperature Rise:

1. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50 degrees C rise above ambient. Heat rise tests shall be conducted in accordance with Underwriters Laboratories Standard UL 67.
2. Provide tin-finished copper bars full length of panel with rating listed in schedule. Bus bar connection to branch circuit breakers shall be "Phase Sequence" type designed and assembled so circuit breakers can be replaced without disturbing adjacent breakers or removing main bus or branch circuit connectors. Provide bus bars with wire lugs suitable for copper or aluminum conductors. Provide each panel with equipment tin finished copper grounding bus grounded to box and tin finished copper neutral bus insulated from box.

#### B. Integrated Equipment Short Circuit Rating

1. Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating as indicated in the schedules. This rating shall be established by testing with the overcurrent devices mounted in the panelboard. The short circuit tests on the overcurrent devices and on the panelboard structure shall be made simultaneously by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

#### C. Cabinet

1. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Provide branch circuit panelboard cabinets with latch and tumbler-type lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike. Endwalls shall be removable. Fronts shall be of code gauge steel. Gray baked enamel finish electrodeposited over cleaned phosphatized steel. Fusible panelboards and large distribution circuit breaker panelboards shall not be provided with doors.

#### D. Safety Barriers

- a. The panelboard interior assembly shall be dead front type with panelboard front removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

#### E. UI Listing

- a. Panelboards shall be listed by Underwriters Laboratories and shall bear the UL label. When required, panelboards shall be suitable for use as service equipment.

### 2.4. OVERCURRENT PROTECTIVE DEVICES

#### A. Main Overcurrent Protection Device

1. The main device shall be a thermal magnetic molded case circuit breaker.

#### B. Branch Circuit Breakers

1. Branch circuit breakers shall be quick-make, quick-break with trip indication. Circuit breakers shall operate both manually for normal switch functions and automatically under overload and short circuit conditions. They shall provide circuit and self-protection when applied within their rating. Operating mechanisms shall be entirely trip free so that contacts cannot be held closed against a short circuit. Operating handle of circuit breaker shall open and close all poles of a multipole breaker simultaneously. Conforming to NEMA Standards Publications No. AB1-1964 and be approved by UL. Circuit breaker shall have a thermal magnetic trip unit for each pole for inverse time delayed overload protection and an instantaneous magnetic element for short circuit protection. Multiple pole trip elements shall operate a common internally connected trip bar to open all poles in case of overload or short circuit through any one pole.
2. Provide arc-fault protection circuit breakers for all sleeping rooms and other areas required by code.

### PART 3 EXECUTION

#### 3.1. EXAMINATION

- A. Examine panelboards before installation. Reject panelboards that are moisture damaged or physically damaged.
- B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. INSTALLATION

- A. Store, handle, and install panelboards and accessories per manufacturer's recommendations.
- B. Secure the assembly in place.
- C. Provide 3½" housekeeping pad where two or more conduits penetrate floor or when equipment is floor/ground mounted.
  - 1. Provide one (1) empty ¾ inch raceway for each three (3) spare unused poles or spaces of each panelboard. Terminate empty ¾ inch conduit in a junction box, which after completion, is accessible to facilitate future branch circuit extension. Cap and mark below grade spare conduits.
- D. Wall-mounted equipment:
  - 1. Mount bottom of trim a minimum of 24" above finish floor. Maintain accessibility to overcurrent devices per NEC. Where both conditions cannot be met, consult with engineer on mounting height of equipment.
  - 2. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
  - 3. Where flush mounted, the fire integrity of the wall in which it is installed must be maintained.
  - 4. Where flush mounted provide (2)2" conduits from the can to above an accessible ceiling and terminate with a minimum 8"x8" junction box located in a concealed manner.
- E. Neatly arrange branch circuit wires and tie together in each gutter with Thomas & Betts nylon "Ty-Raps", or approved equal at minimum 4 inch intervals.
- F. Plug all knockouts removed and not utilized.
- G. Install overcurrent protective devices and controllers not already factory installed.
- H. Install filler plates in unused spaces.

#### 3.3. IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. For panelboards (and distribution panelboards where labeling of individual breakers is not possible or practical), provide a typed circuit directory for same as follows:
  - 1. Panels shall have branch circuit directory holders with clear plastic cover.
  - 2. Provide neatly typed list of branch circuit loads corresponding to branch circuit numbers. Handwritten directories are not acceptable.
  - 3. For remodel work or changes, trace circuits to determine loads and provide new updated directory.

#### 3.4. 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. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, and feeder.
  - 2. Test continuity of each circuit.
- C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5. ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated in the coordination study.

3.6. LOAD BALANCE

- A. 30 days after occupancy provide record ampacity loads for each panelboard by phase.
- B. Adjust circuit and phase loading so that each phase is within 25% of other phases if possible.
- C. Update circuit directory with new typewritten directory with any circuit changes for balance of loads.
- D. Update any labels on equipment, receptacles etc to any circuit changes due to balancing.

3.7. TOUCH UP AND CLEANING

- A. Vacuum all backboxes clean of debris after installation and prior to contract closeout.
- B. Touch up scratch marks, etc. with matching paint.

3.8. OBSERVATIONS

- A. All panel fronts shall be removed by the Contractor for observation of the panel interiors by the Engineers.
- B. Panel fronts shall be removed when directed by the Engineer/Architect for observation and reinstalled immediately after the observations.

**END OF SECTION 262416**

## SECTION 262726 – WIRING DEVICES

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

#### 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. Comply with NFPA 70.

### PART 2 PRODUCTS

#### 2.1. GENERAL

- A. Manufacturers
  - 1. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
    - a. Eaton Wiring Devices; (may be listed below and/or submitted as Eaton, Cooper, Arrow Hart, or Crouse-Hinds).
    - b. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
    - c. Leviton Mfg. Company Inc. (Leviton).
    - d. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
  - 2. All devices shall be from the same manufacturer.
- B. Finishes
  - 1. Color: Wiring device catalog numbers in Section Text do not designate device color.
    - a. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
    - i. Color shall be coordinated and verified with Architect and owner.

#### 2.2. STRAIGHT BLADE RECEPTACLES

- A. General Requirements for Convenience Receptacles
  - 1. Unless otherwise modified below, all receptacles shall comply with the following:
  - 2. Commercial / Common Areas: 125 V, 20 A
  - 3. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 4. Multiple types of receptacles may be required of a single device (Ex.: a Hospital-Grade GFCI receptacle), as indicated on the plans and in the execution section below. Where such a device is required, it shall meet the requirements of all applicable sections below.
  - 5. Products: Subject to compliance with requirements, provide one of the following:
    - a. Refer to list of approved manufacturers in general section.
    - b. Receptacle model/series(all manufacturers): 5361 (single), 5362 (duplex).
- B. GFCI Receptacles
  - 1. Straight blade, feed or non-feed-through type.
  - 2. Include indicator light that is lighted when device is tripped.
  - 3. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; SGF20.
    - b. Hubbell; GFRST20.
    - c. Leviton; G5362.

- d. Pass & Seymour; 2097.
- 4. Where devices are shown labeled as GFI on drawings provide GFCI receptacle (feed-through devices are not acceptable unless otherwise noted, or with written permission from the engineer).
  - a. Devices labeled as GFIP on the drawings may be protected as a feed-through device.
- C. Weather-Resistant Receptacles
  - 1. Receptacles shall UL-listed as weather-resistant.
  - 2. Receptacles shall be identified with an "WR" on the receptacle face.
  - 3. Products: Refer to General Requirements for Convenience Receptacles. WR receptacles shall be of same series.
- D. Tamper-Resistant Receptacles
  - 1. Tamper-Resistant Receptacles shall be safety type, "childproof," duplex, 3 wire, ground type.
  - 2. Products: Refer to General Requirements for Convenience Receptacles. TR receptacles shall be of same series.

### 2.3. SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Catalog numbers in subparagraphs below are for 20-A devices; revise catalog numbers if 15-A devices are desired.
    - b. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    - c. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - d. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    - e. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221PL for 120 V and 277 V.
    - b. Hubbell; HPL1221PL for 120 V and 277 V.
    - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
    - d. Pass & Seymour; PS20AC1-PLR for 120 V.
  - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 2221L.
    - b. Hubbell; HBL1221L.
    - c. Leviton; 1221-2L.
    - d. Pass & Seymour; PS20AC1-L.
  - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.

### 2.4. WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
  - 1. 600 W; dimmers shall require no derating when ganged with other devices.
  - 2. 2000 W; dimmers where required by load.
- D. Dimmer Switches for LED fixtures: Modular; compatible with dimming drivers in fixture(s); if other than 0-10V dimming is provided, verify dimmer is compatible with driver for full range of dimming (100-10%).

### 2.5. OCCUPANCY SENSORS

- A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Cooper; 6111 for 120 V, 6117 for 277 V.
  - b. Hubbell; WS1277.
  - c. Leviton; ODS 10-ID.
  - d. Pass & Seymour; WS3000.
  - e. Steinel; IL WLS 1.
  - f. Watt Stopper (The); PW-101.
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

B. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Hubbell; ATP1600WRP.
  - b. Leviton; ODWWV-IRW.
  - c. Pass & Seymour; WA1001.
  - d. Steinel; IL WLS 1
  - e. Watt Stopper (The); CX-100.
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft..

2.6. SPECIAL PURPOSE DEVICES

- A. Provide where indicated, specified or as required other appropriate NEMA configured devices appropriate for such equipment as thru-wall units manufactured by the same manufactures.

2.7. WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: 0.035-inch-thick, satin-finished stainless steel.
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable in-use cover.
- C. Damp-Location, Damp Location Cover Plates: NEMA 250, spring loaded and gasketed, die-cast aluminum.

PART 3 EXECUTION

3.1. INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.

- b. Straighten conductors that remain and remove corrosion and foreign matter.
- c. Pigtail existing conductors is permitted provided the outlet box is large enough.

D. Receptacle Types:

1. The following receptacle types shall be furnished in lieu of "standard" 120V, 15 or 20 amp receptacles at all of the following locations, regardless of plan designation:
  - a. Refer to the National Electrical Code (NEC), for definitions of all locations listed below.
2. GFCI Receptacles:
  - a. Bathrooms / Locker Rooms
  - b. Kitchens (unless circuit is provided with GFCI protection at the circuit breaker)
  - c. Rooftops
  - d. Outdoors
  - e. Where located within 6'-0" of a sink.
  - f. Garages, Service Bays, etc.
  - g. Unfinished areas.
3. Weather-Resistant Receptacles:
  - a. In all damp or wet locations.

E. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Wall plates shall not support wiring devices. Provide wiring device with accessories as required to properly install devices and wall plates.
11. All devices shall be flush-mounted except as otherwise noted on the drawings.
12. Locations
  - a. Comply with layout drawings for general location; contact Owner's Representative for questions about locations and mounting methods.
  - b. Relocate outlets obviously placed in a location or manner not suitable to the room finish.
  - c. Avoid placing outlets behind open doors.
  - d. Align devices vertically and horizontally. Device plates shall be aligned vertically with tolerance of 1/16". All four edges of device plates shall be in contact with the wall surface.
13. Mounting Heights as indicated on the Drawings and according to ADA requirements.
14. Ganging of Switches - provide barriers between ganged 277 volt switches of different phases.
15. Power Outlets - install power outlets complete with back boxes, where installed in existing buildings or extensions of existing buildings. Coordinate phase connections for rotating equipment with connections in existing building.
16. Install device plates on all outlet boxes. Provide blank plates for all empty, spare and boxes for future devices.
17. Caulk around edges of outdoor device plates and boxes when rough wall surfaces prevent a raintight seal. Use caulking material as approved by the Architect/Engineer.
18. Emergency/normal power devices and/or 277V/120V devices are not to occupy the same box. Where same are shown on plans to be ganged, provide separate boxes immediately adjacent to each other.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up.

G. Device Plates:

1. Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
2. Provide matching blank wall plates to cover outlet or junction boxes intended for future devices.
3. Provide matching blank wall plates with 4 port knock outs at all telephone, data, and tele/data outlet locations. Also provide with matching blankouts in each port.
4. Where wall plates for special devices are available only from manufacturer of device, provide designs and finishes equivalent to above specification.
5. Verify with Architect finish of any plate where it may be apparent a special finish or color should have been specified.

H. Switches

1. Where switches are indicated to be installed near doors, corner walls, etc., mount same not less than 2 inches and not more than 18 inches from trim. Verify exact locations with the Architect.
2. Carefully coordinate the location of switches to insure locations at the strike side of doors.
3. Furnish and install an engraved legend for each switch that controls exhaust fans, motors, equipment systems, etc., not located within sight of the controlling switch.

I. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

J. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

K. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

3.2. IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3. FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

B. Tests for Convenience Receptacles:

1. Test for correct wire terminations (no open ground, neutral, or hot).
2. Test for correct polarity (no hot/ground reverse or hot/neutral reverse).
3. Verify GFCI devices are operating properly.
4. Using the test plug, verify that the device and its outlet box are securely mounted.

**END OF SECTION 262726**

## SECTION 262813 – FUSES

### PART 1 GENERAL

#### 1.1. SUBMITTALS

- A. First paragraph below is defined in Division 01 Section "Submittal Procedures" as an "Action Submittal."
- B. Product Data: For each type of product indicated.
- C. Paragraph below is defined in Division 01 Section "Submittal Procedures" as an "Informational Submittal."
- D. Operation and maintenance data.

#### 1.2. QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.

### PART 2 PRODUCTS

#### 2.1. FUSES

##### A. PRODUCT

- 1. Provide fuses by Bussman or Gould Shawmut.
- 2. Provide fuses of same characteristics as scheduled to insure selective coordination of power system.
- 3. Fuses 601 amp and larger shall be U/L Class L with minimum four (4) seconds time delay at 500% rating.
- 4. Fuses 600 amp and below shall be U/L Class J, RK-1 or RK-5 as scheduled time delay sized as shown on drawings or schedules.
- 5. Special temperature conditions, motors, motor loads or other conditions requiring other types or sizes of fuses must be reviewed by the Contracting Officer. Fuse reducers are not permitted.

### PART 3 EXECUTION

#### 3.1. INSTALLATION

- A. Install fuses only after installation is complete and final tests and inspections have been made. Label fuses, switches and other fused devices with warning labels affixed in prominent location indicating type and size of fuse installed and fuse manufacturer's catalog number.
- B. Furnish Owner with spare fuses of each size and type installed on job as follows:
  - 1. 601 Amps or Larger - three (3) of each size and type
  - 2. 600 Amps or Less - 10% with minimum of three (3) of each size and type
- C. For fuse types and ampacities, see plans.
- D. Provide spare fuse cabinet with three shelves.
- E. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

**END OF SECTION 262813**

## SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

#### 1.3. QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1. DISCONNECT SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton (Cutler-Hammer)
  - 2. General Electric Company
  - 3. Siemens
  - 4. Square D
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  - 3. Lugs: Suitable for number, size, and conductor material.
  - 4. Service-Rated Switches: Labeled for use as service equipment.

#### 2.2. FUSIBLE SWITCHES

- A. Refer to disconnect switches for all requirements in addition to the following.
- B. Switches shall be furnished with clips or bolt pads to accommodate indicated fuses.
- C. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the label may be easily read from the front and without removing the fuse.
- D. Accessories:
  - 1. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

#### 2.3. MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton (Cutler-Hammer)
  - 2. General Electric Company
  - 3. Siemens
  - 4. Square D
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories (where called for or required):

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

**2.4. ENCLOSURES**

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R.
  3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
  4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
  5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

**PART 3 EXECUTION**

**3.1. INSTALLATION**

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.

**3.2. IDENTIFICATION**

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved metal or laminated-plastic nameplate.

**3.3. FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**END OF SECTION 262816**

## SECTION 262913 – ENCLOSED CONTROLLERS

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of enclosed controller.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

#### 1.3. QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1. MOTOR STARTERS

- A. Provide motor starters rated in accordance with NEMA and as specified and shown on plans.
  - 1. Equivalents by: G.E., Cutler Hammer, or I.T.E. Siemens, Square D.
  - 2. Install starters in locations as shown on plans, installation shall be in strict accordance with NEC, and manufacturer's installation requirements.
- B. MAGNETIC MOTOR STARTERS
  - 1. Provide 600 volt, 60 hertz AC across-the-line magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.
  - 2. Enclosures shall be NEMA type required by starter location and environment.
  - 3. Starter shall have permanently affixed to inside of enclosure cover an easy to read wiring diagram, including alternate control variations and a warning sign indicating maximum current limiting fuse size that may be installed in disconnect switch which will limit fault current to starters withstand rating with 100,000 RMS fault current available at disconnect switch.
  - 4. Starter contacts shall be silver alloy double break replacement without removal of power wiring or starter from enclosure.
  - 5. Provide starter with solid state type overload relays on all phases. Overload thermal unit shall be one piece interchangeable construction. Overload relays shall provide phase loss and phase failure protection. Starter shall be inoperative with overload unit removed. Starters shall not be furnished to Electrical Contractor with jumper straps in overload units.
  - 6. Ampere rating for overload relays shall be selected by multiplying motor nameplate running amperes at connected voltage by .90 for motors with 1.0 service and by .95 for motors with 1.15 service factor. Use resulting amperes to enter manufacturer's overload selection tables. Keep record of thermal unit number and current range.
  - 7. Provide starter with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required. When starter voltage exceeds 120 volts, provide 120 volt control circuit transformer with two Dual Element Fuses in transformer primary and one fuse in the secondary.
  - 8. Starter shall be suitable for addition of at least four electrical interlocks of any arrangement of normally open or closed contacts.
  - 9. Provide starter with the following accessories: auxiliary contacts, pilot light, and H.O.A. switch.
  - 10. Starter applications requiring disconnect switch at starter shall be combination type motor starters in lieu of separate devices.
- C. COMBINATION MAGNETIC MOTOR STARTERS
  - 1. Provide 600 volt, 60 hertz AC across-the-line fusible or non-fusible as scheduled magnetic type rated in accordance with NEMA Standards and listed and labeled in accordance with UL Standard 508 Eleventh Edition.

2. Starter NEMA enclosure type shall be type required for starter location and environment.
3. Combination starter shall be a factory assembled unit with internal wiring and control circuits prewired with only line, load, and external control circuit wiring connections required.
4. Where fusible CMS are called for fuse holders shall be high pressure suitable for use with dual element fuses or rejection type current limiting fuses where required.
5. Fuse holders shall be completely accessible from front of switch and fuses shall be installed so that the fuse type and size may be easily read from the front and without removing the fuse.
6. All fuse holders shall have rejection clips installed.
7. See plans for combination magnetic starters.

D. MANUAL MOTOR CONTROL (1 HP Maximum)

1. Provide 300 volt, 60 cycle, AC manually operated motor starting switch meeting current NEMA Standards with proper NEMA enclosure required by starter location and environment.
2. Starter shall have heavy silver alloy contacts with quick-make, quick-break mechanism manually operated by toggle switch.
3. Thermal unit shall be melting alloy type, resettable, one-piece interchangeable construction.
4. Provide starter with all accessories such as pilot light, H.O.A. or two speed switches required to provide control sequence shown on drawings or specified. Selector switches contact shall have same ampere rating as starter switch.

### PART 3 EXECUTION

#### 3.1. INSTALLATION

- A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height, and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch nominal-thickness concrete base.
  1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in each fusible-switch enclosed controller.
- E. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section "Fuses."
- F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- G. Comply with NECA 1.

#### 3.2. IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved nameplate.
  3. Label each enclosure-mounted control and pilot device.

#### 3.3. CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers and remote devices[ and facility's central control system]. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
  1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
  2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.4. FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
  - 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
  - 3. Test continuity of each circuit.
  - 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
  - 5. Test each motor for proper phase rotation.
  - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5. ADJUSTING

- A. Set field-adjustable switches and overload-relay pickup and trip ranges.
- B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

### 3.6. DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

**END OF SECTION 262913**

## SECTION 264300 – SURGE PROTECTION DEVICES

### PART 1 GENERAL

#### 1.1. SCOPE

- A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

#### 1.2. RELATED SECTIONS

- A. Reference Section 260010.
- B. Section 262413 – Switchboards
- C. Section 262416 – Panelboards

#### 1.3. SUBMITTALS

- A. The following information shall be submitted to the Engineer:
  - 1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current ( $I_n$ ).
  - 2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.
- B. Where applicable the following additional information shall be submitted to the engineer:
  - 1. Descriptive bulletins
  - 2. Product sheets
- C. The following information shall be submitted for record purposes:
  - 1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process

#### 1.4. QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.
- E. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

#### 1.5. DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

#### 1.6. OPERATION AND MAINTENANCE MANUALS

- A. Operation and maintenance manuals shall be provided with each SPD shipped.

### PART 2 PRODUCTS

#### 2.1. MANUFACTURERS

- A. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

B. Furnish Integral SPDs by one of the following:

1. Eaton / Cutler-Hammer products
2. Siemens
3. Square D
4. GE

C. External SPDs may be furnished by the gear manufacturer (listed above) or by one of the following:

1. Erico
2. SSI (Surg Suppression LLC)

2.2. VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

5. Nominal Discharge Current ( $I_n$ ) – All SPDs applied to the distribution system shall have a 20kA  $I_n$  rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an  $I_n$  less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
  - a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

- i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
    - ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
    - iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
  - b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
  - c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
  - d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of  $50 \pm 20A$  occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
    - i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
6. SPD Mounting – refer to plans and panelboard schedules indicating where SPDs are required to be mounted integral to panelboards and where they may be side-mounted.
7. Overcurrent Protection
  - a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
8. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
9. Safety Requirements
  - a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
  - b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
  - c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

### 2.3. SYSTEM APPLICATION

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate

suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

- B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

- C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

#### 2.4. LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

- A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
1. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
  2. The SPD shall be of the same manufacturer as the panelboard.
  3. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
  4. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
  5. The panelboard shall be capable of re-energizing upon removal of the SPD.
  6. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
  7. The complete panelboard including the SPD shall be UL67 listed.
- B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)
1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

#### 2.5. SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS

- A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
1. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway
  2. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer
  3. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
  4. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
  5. All monitoring and diagnostic features shall be visible from the front of the equipment.
- B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)
1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

#### 2.6. ENCLOSURES

- A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount

- units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
  3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

### PART 3 EXECUTION

#### 3.1. FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

#### 3.2. INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

#### 3.3. WARRANTY

- A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

**END OF SECTION 264300**

## SECTION 265000 – LIGHTING

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260500.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2. SUBMITTALS

- A. Product Data:
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.
  - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  - 6. Photometric data and adjustment factors based on laboratory tests
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- D. Field quality-control test reports.
- E. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

### PART 2 - PRODUCTS

#### 2.1. INSPECTION

- A. Prior to installation of luminaires Electrical Contractor shall inspect luminaire and verify unit meets or exceeds specifications, is new and unused without damage or defect and is suitable for the intended service.
- B. See architectural and electrical plans for luminaire locations, coordinate installation with other trades. At the completion of the project all luminaires shall be aligned, level and cleaned to the satisfaction of the A/E.

#### 2.2. EQUIVALENT MANUFACTURERS

- A. The following light fixture manufacturers are generally approved equals to those manufacturers listed in the Lighting Fixture Schedule on the drawings. The approval herein no way relieves the contractor of meeting all specification requirements. All light fixtures substituted for fixtures specified on drawings must conform in materials, dimensions, appearance, performance, and be of equal quality to the fixture specified and described in the Lighting Fixture Schedule. Fixture manufacturers not listed here must be submitted and approved a minimum of 10 days prior to bid.
- B. Provide luminaires by the following manufacturers:
- C. Downlights:
  - 1. Category 1: (Only Category 1 fixtures may be substituted for Category 1 fixtures specified on the drawings). Calculite, Edison Price, Focal Point, Kirlin, Kurt Versen, Rambusch, RSA, USA Lighting, USAI Lighting
  - 2. Category 2: (Category 1 or Category 2 fixtures may be substituted for Category 2 fixtures specified on the drawings). Elite, Halo, Hubbell, Indy, Intense, Lightolier, Lithonia, Marko, Nulite, Pathway, Prescolite, Portfolio, Spectrum, Williams, Zumtobel
- D. LED/Fluorescent Troffer Type: Columbia, Cooper (Metalux), Daybrite, Elite, Finelite, Focal Point, Lithonia, Williams
  - 1. Equivalent troffers shall be considered the following: Columbia (PS Series), Cooper (Metalux GC Series), Daybrite (SP Series), Elite (OT Series), Finelite (HPR Series), Lithonia (SP Series), Williams (50 Series)
- E. Undercounter: Columbia, Color Kinetics, Daybrite, Elite, Fail-Safe, Lithonia, Metalux, Nulite, Viscor Lighting, WAC, Williams
- F. Strip Fluorescents: Birchwood, Columbia, Daybrite, Elite, ILP, Lithonia, Metalux, Paramount, Prudential, Utopia Lighting, Williams

- G. Linear/Tubes: A Light, Corelite, Finelite, Focal Point, Ledalite, Linear Lighting, LiteControl, Mercury Architectural Lighting, Metalumen, Peerless, PMC, Precision, Prudential, Utopia Lighting, Williams, Zumtobel
- H. Specialty Lights: Advent, Baselite, Bega, Beta Calco, Casey Architectural, Cole, Crenshaw Lighting, Design Plan, Engineered Lighting Products, Focal Point, G Lighting, iGuzzini, Impact Lighting, Interlux, Juno, Justice Design, Kramer, Louis Poulson, Lighting Services Inc., Neoray, Prudential, Sharper, SPI, Manning, MP Lighting, Sistemalux, Sterner, Tivoli, Trend Lighting, Trimblehouse, Ultra Lights, Visa, Visual Lighting Technologies, WAC, Winona, Zaneen, Zumtobel
- I. Indirect: Ametrix, Elliptipar, Engineered Lighting Products, Focal Point, LiteControl, SPI, Zumtobel
- J. Industrial: ABS Lighting, Crouse Hinds, Daybrite, Gardco, G.E., Holophane, Hubbell, Lumark, Kim, Lithonia, SPI, Williams
- K. Exit Signs and Emergency Lights: Beghelli, Chloride, Concealite, Devine, Dual-Lite, EELP, Elite, Emergi-Lite, Evenlite, Exitronix, Fail-Safe, Hubbell, Isolite, Lithonia, Prescolite, Surelites, Crouse Hinds, Williams.
- L. Security/Vandal Resistant: Daybrite, Eclipse, Failsafe, Holcor, Kenall, Kirlin, L.C. Doane, Moldcast.
- M. Hazardous Locations: Appleton, Chloride, Cross-Hinds, Daybrite, Dialight, Dual-Lite, Halo, Hubbell, Kirlin, L.C. Doane, Paramount, Phoenix
- N. Outdoor: ABS Lighting, Antique Street Lights, Architectural Area Lighting, Bega, Beta Calco, Daybrite, Devine, Excelsior, Gardco, G.E., Hadco, Hubbell, Holophane, Hydrel, Invue, Kim, King Luminaire, Lithonia, LSI Lighting Systems, Lumark, Lumec, Lumiere, Lumenton, McGraw-Edison, McPhilben, Ruud, Sterner, Stonco, Sun Valley Lighting, US Architectural, Vista Pro, Williams.
- O. Track Lighting: Alfa, Bruck, Elite, Halo, Intense, Lithonia, Lightolier, Lighting Services Inc., Lite Lab, Marko, Prescolite
- P. LED lamps and Modules: Philips, General Electric, Osram/Sylvania, Cree, Nichia.
- Q. LED Power Supplies: Osram/Sylvania, General Electric, Philips.

### 2.3. LUMINAIRES

- A. Provide luminaires complete with lamps and accessories required for hanging. Contractor shall insure that lamps, reflector lens and trim are clean at time of final inspection. Mount recessed luminaires with trim flush to ceilings, free of gaps or cracks.
- B. Coordinate mounting of ceiling mounted luminaires with General Contractor. Where additional supports are required due to luminaire location or weight, electrical contractor shall provide supports, unless otherwise specified under ceiling specifications.
- C. Consult architectural plans and existing conditions where applicable for ceiling types and provide surface and recessed lighting fixtures with appropriate mounting components and accessories. Verify mounting requirements prior to ordering and shop drawing submission.
- D. All fixtures and components mounted in areas lower than 8'-0" or in mechanical, electrical or service type areas subject to circulation of staff or maintenance shall be coordinated prior to installation so as to minimize damage or injury. Any devices or fixtures mounted without coordination/notification with architect that become hazards to walk paths or subject to damage shall be moved at no expense to the owner at the satisfaction of the architect/engineer. (ie. if a fixture can be located a short distance away that avoids a beam or prevents it from being mounted 3" above a persons head that should be coordinated prior to installation)
- E. Fixtures mounted in fire rated ceilings shall be provided and installed with fire rated enclosures to maintain ceiling integrity. Provide engineered products by EZ-Barrier, Tenmat or similar products or provide enclosures fabricated in accordance with building code and UL requirements. Maintain all fixture required heat sink and other clearances.

### 2.4. LED LIGHTING SYSTEMS

- A. LED components, lamps, drivers, and fixtures shall comply with: PCC 47 CFR Part 15; UL 8750; ANSI/NEMA Standards C78.377, NEMA SSL-1, C82.77, IESNA Standards TM-16-05, RP-16, LM-79, LM-80 and TM-21.
- B. The LED module itself and all its components must not be subject to mechanical stress.
- C. Assembly must not damage or destroy conducting paths on the circuit board.
- D. Installation of LED modules (with power supplies) shall adhere to all applicable electrical and safety standards.
- E. Correct polarity shall be clearly identified.
- F. LED module must be protected from unbalanced voltage drop, and/or overload.
- G. Ensure that the power supply is of adequate power to operate the load.
- H. Install system according to manufacturer's heat sinking parameters.
- I. For applications involving exposure to humidity and dust, the module shall be protected by a fixture or housing with a suitable protection glass. The module shall be protected against condensation water by treatment with an appropriate circuit board conformal coating. The conformal coating should have the following features.
  - 1. Optical transparency
  - 2. UV resistance
  - 3. Thermal expansion properties matching those of the module (15-30 x 10<sup>-6</sup>cm/cm/K)
  - 4. Low permeability of steam for all climate conditions
  - 5. Resistance against corrosive environments

- J. The LED module shall be operated with an electronically stabilized power supply offering protection against short circuits overload and overheating.
- K. All drivers used for supplying power to LED arrays in lighting fixtures shall be by the light fixture manufacturer.
- L. Drivers shall be integral to the fixture unless otherwise shown or specified.

### **PART 3 - EXECUTION**

#### **3.1. LUMINAIRES**

- A. All light fixtures shall be cleaned and free of all construction debris. Install units as shown and detailed on the plans and per manufacturers' directions.
- B. Reference luminaire schedule on plans for specific luminaire, lamp, and ballast requirements.
- C. Reinstall any fixtures called out for relocation or remounting in renovation areas as though they are new fixtures. Make all provisions to properly mount and support existing fixtures being reused.
- D. Luminaires submitted must meet or exceed specified luminaire in performance and construction and appearance. Provide luminaires at each location shown on drawings. Luminaires shall be in accordance with type designation on drawings.

#### **3.2. ADJUSTMENTS**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
- B. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
- C. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- D. Adjust the aim of luminaires in the presence of the Architect.

#### **3.3. FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

**END OF SECTION 265000**

## SECTION 265100 – INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Reference Section 260500 for general requirements of all light fixtures.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### PART 2 - PRODUCTS

#### 2.1. LUMINAIRES

- A. Provide luminaires complete with lamps and accessories required for hanging. Contractor shall insure that lamps, reflector lens and trim are clean at time of final inspection. Mount recessed luminaires with trim flush to ceilings, free of gaps or cracks.
- B. Coordinate mounting of ceiling mounted luminaires with General Contractor. Where additional supports are required due to luminaire location or weight, electrical contractor shall provide supports, unless otherwise specified under ceiling specifications.
- C. Consult architectural plans and existing conditions where applicable for ceiling types and provide surface and recessed lighting fixtures with appropriate mounting components and accessories. Verify mounting requirements prior to ordering and shop drawing submission.
- D. Fixtures mounted in fire rated ceilings shall be provided and installed with fire rated enclosures to maintain ceiling integrity. Provide engineered products by EZ-Barrier, Tenmat or similar products or provide enclosures fabricated in accordance with building code and UL requirements. Maintain all fixture required heat sink and other clearances.
- E. Provide troffer luminaires with the following devices wherever possible and not specified otherwise on the luminaire schedule: cam latches, 100% door gasketing, post fabrication painted finish, t-bar clips, lens clips, suspension tabs, and a minimum of 0.125" lens.

#### 2.2. EMERGENCY LED DRIVER

- A. Emergency LED driver specified herein is by Iota (CP Series). Approved equals by Bodine.
  - 1. The emergency driver shall accommodate an LED load with a forward voltage requirement ranging from 10 to 60 VDC.
  - 2. The output voltage sensing shall be automatic and instantaneous with a resulting, inversely-proportional current to maintain constant power to the LED array with an output tolerance of +/- 3%.
  - 3. The unit shall supply the rated load for a minimum of 1 1/2 hours or to 87 1/2% of rated battery terminal voltage.
  - 4. The output power to the LED load during emergency operation shall be held constant (refer to plans for wattage) from minute one throughout the entire emergency run time resulting in no loss or degradation of the light source during emergency operation.
  - 5. The unit shall be furnished with an electronic, AC-lockout circuit which will connect the battery when the AC circuit is activated, and an electronic brownout circuit which will enable a transfer to emergency operation when utility power dips below an acceptable level.
- B. Installation
  - 1. Emergency drivers shall be UL-listed for use with respective LED array and/or UL-listed for field installation. Where drivers are only listed for use with a respective LED array, they shall be installed integral to the fixture by the fixture manufacturer.
  - 2. Maximum remote mounting distance of the emergency driver shall be 50-feet
- C. Driver: Constant Power emergency LED driver system as indicated on the plans. The emergency driver system shall be UL class 2 certified in accordance with UL 1310 and shall be UL listed for use in damp locations with a temperature range of 0° to 55° C.
- D. AC input: Two-wire, universal voltage capable 120 thru 277 VAC, 50/60 Hz and be UL Classified to Category Control Number (CCN) FTBR, Emergency Lighting and Power Equipment, and FTBV, Emergency Light-Emitting-Diode Drivers for field installation.
- E. Battery: Self-contained, high-temperature, sealed, maintenance-free nickel cadmium battery rated for a 10-year service life.
- F. Charger: two-stage charging system which samples the battery in relation to its temperature, state of charge and input voltage fluctuations. The charger shall be current limited, temperature compensated, short-circuit protected with reverse polarity protection. The unit shall achieve a full recharge in 24-hours.
- G. Protection: A low voltage battery disconnect (LVD) circuit shall be provided and will disconnect the load and

circuitry from the battery when it reaches approximately 80 to 85% of its nominal terminal voltage, preventing a non-recoverable, deep-discharge condition as well as equipment initialization failure when utility power is restored.

- H. Housing: NEMA 250, Type 1 enclosure.
- I. Test Push Button: Illuminated push-to-test switch.
- J. Provide 5-year warranty.

### **PART 3 - EXECUTION**

#### **3.1. LUMINAIRES**

- A. Luminaire supports shall comply with the latest edition of the NEC Sections 410-30 and 410-36. Provide luminaire securing clips or otherwise securely fasten fixtures to ceiling grid. At least two support wires shall be connected from the structure above to each troffer style light fixture.

#### **3.2. INSTALLATION**

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. All light fixtures shall be cleaned and free of all construction debris. Install units as shown and detailed on the plans and per manufacturers' directions.
- C. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
  - 1. Install a minimum of two ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
  - 5. Fixtures shall not be supported by the ceiling structure only without being installed in a ceiling listed, designed and installed for proper support of fixtures. Cables, clips, etc may not be omitted without documentation of ceiling capacity and design and installation is listed for such use and as applied for the project.
- D. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- E. Air-Handling Lighting Fixtures: Install with dampers open and ready for adjustment.
- F. Adjust aimable lighting fixtures to provide required light intensities
- G. Recessed luminaires installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate not more than 2.0 cfm (0.944 L/s) when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.
- H. Recessed luminaires installed in rated assemblies shall be installed per UL listing requirements to maintain the rating of the construction. Provide sheet rock enclosures or other UL listed manufactured assemblies to maintain rating of construction and listing of fixtures for heat dissipation and clearances.

**END OF SECTION 265100**

## SECTION 265600 – EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1. RELATED DOCUMENTS

- A. Reference Section 260010.
- B. Reference Section 265000 for general requirements of all light fixtures.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### PART 2 - PRODUCTS

#### 2.1. POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4.
  - 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
  - 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
  - 1. Materials: Shall not cause galvanic action at contact points.
  - 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
  - 3. Anchor-Bolt Template: Plywood or steel.
- D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

#### 2.2. STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; 1-piece construction up to 40 feet in height with access handhole in pole wall.
  - 1. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Steel Mast Arms: [Single-arm] [Truss] [Davit] type, continuously welded to pole attachment plate. Material and finish same as pole.
- C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
  - 1. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
  - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
  - 3. Match pole material and finish.
- D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.
- F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Color shall be as selected by Architect.

#### 2.3. ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.
- B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors

- of type and size listed in that Section, and accessible through handhole.
- D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
    - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
    - 2. Finish: Same as pole and luminaire.
  - E. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Color shall be as selected by Architect from manufacturer's full range.

#### 2.4. POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

### PART 3 - EXECUTION

#### 3.1. EXTERIOR POLE AND GROUND MOUNTED FIXTURE INSTALLATIONS

##### A. POLE INSTALLATION

- 1. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- 2. See Evaluations for structural- and soil- engineering coordination.
- 3. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.
- 4. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
  - a. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  - b. Install base covers, unless otherwise indicated.
  - c. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- 5. Raise and set poles using web fabric slings (not chain or cable).

##### B. BOLLARD LUMINAIRE INSTALLATION

- 1. Align units for optimum directional alignment of light distribution.
- 2. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth.

##### C. INSTALLATION OF GROUND-MOUNTED FLOODLIGHT LUMINAIRES

- 1. Floodlights shall be mounted by stanchion or other similar accessory furnished with fixture – see fixture schedule and details for same.
  - a. Mounting of floodlights supported from grade by conduit only (may also be referred to as "junction box" method) is not acceptable.
- 2. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit and mounting provisions into base, and finish by troweling and rubbing smooth.

##### D. CORROSION PREVENTION

- 1. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- 2. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

##### E. GROUNDING

- 1. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
  - a. Install grounding electrode for each pole, unless otherwise indicated.
  - b. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- 2. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and

Bonding for Electrical Systems."

- a. Install grounding electrode for each pole.
- b. Install grounding conductor and conductor protector.
- c. Ground metallic components of pole accessories and foundations.

**END OF SECTION 265600**

**END OF DIVISION 260000**

**END OF DIVISION 260000**

**DIVISION 27**  
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**SECTION 270500 – COMMON WORK FOR COMMUNICATIONS**  
**SECTION 271100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

SECTION 270500 – COMMON WORK FOR COMMUNICATIONS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

- A. Division 26 specifications govern the construction methods, materials and other aspects related to electrical work contained in these Division 27 specifications.
- B. Reference
  - 1. Section 260010 - Electrical Provisions
  - 2. Section 260011 - Basic Electrical Materials And Methods
  - 3. Section 260013 - Project Coordination
  - 4. As well as other Division 26 Sections for any other electrical requirements and provisions.
- C. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

**END OF SECTION 270500**

## SECTION 271100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

### PART 1 GENERAL

#### 1.1. SCOPE

- A. Provide rough-in and provisions for cabling by others.

#### 1.2. SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies, and location and size of each field connection.
  - 2. Equipment racks and cabinets: Include workspace requirements and access for cable connections.
  - 3. Grounding: Indicate location of grounding bus bar and its mounting detail.
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

#### 1.3. COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.
  - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

### PART 2 PRODUCTS

#### 2.1. PATHWAYS

- A. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems"
  - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

#### 2.2. BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96.

#### 2.3. GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
  - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
  - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
  - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

### PART 3 EXECUTION

#### 3.1. ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.
- C. Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems."

3.2. INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

3.3. GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. 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.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

**END OF SECTION 271100**

**END OF DIVISION 270000**

END OF DIVISION 270000

## SECTION 323119 - DECORATIVE METAL GATES

### 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. Swing gates.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For gates.
  - 1. Include plans, elevations, sections, gate locations, post spacing, and mounting details, and grounding details.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For gate operators to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

### PART 2 - PRODUCTS

#### 2.1 DECORATIVE STEEL FENCES

- A. Decorative Steel Fences: Fences made from steel tubing bars and shapes, hot-dip galvanized.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ameristar Perimeter Security; ASSA ABLOY.

- B. Rails:
  - 1. Steel Tube Rails: Square steel tubing 2 by 2 inches with 1/8-inch wall thickness.
- C. Pickets: 1 inch square by 0.065-inch steel tubes.
  - 1. Terminate tops of pickets at top rail for flush top appearance.
  - 2. Picket Spacing: 4 inches clear, maximum.
- D. Fasteners: Stainless-steel carriage bolts and tamperproof nuts.
- E. Finish exposed welds to comply with NOMMA Guideline 1, Finish #4 - good-quality, uniform undressed weld with minimal splatter.
- F. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.
  - 1. Hot-dip galvanize rail and picket assemblies after fabrication.
- G. Finish for Steel Items: High-performance coating.

## 2.2 SWING GATES

- A. Gate Configuration: Single leaf.
- B. Gate Frame Height: 60 inches at 4" above concrete.
- C. Gate Opening Width: As indicated.
- D. Steel Frames and Bracing: Fabricate members from square steel tubing 1-1/2 by 1-1/2 inches with 1/8-inch wall thickness. Hot-dip galvanize frames after fabrication.
- E. Frame Corner Construction: Welded.
- F. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- G. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
- H. Hardware: Latches permitting operation from both sides of gate, hinges, and keepers for each gate leaf. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
- I. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
  - 1. Function: 39 - Full surface, triple weight, antifriction bearing.
  - 2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- J. Finish exposed welds to comply with NOMMA Guideline 1, Finish #4 - good-quality, uniform undressed weld with minimal splatter.

- K. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A123/A123M. For hardware items, hot-dip galvanize to comply with ASTM A153/A153M.

## 2.3 STEEL AND IRON

- A. Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- C. Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Bar Grating: NAAMM MBG 531.
  - 1. Bars: Hot-rolled steel strip, ASTM A1011/A1011M, Commercial Steel, Type B.
  - 2. Wire Rods: ASTM A510/A510M.

## 2.4 COATING MATERIALS

- A. Shop Primer for Steel: Manufacturer's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

## 2.6 STEEL FINISHES

- A. Surface Preparation: Clean surfaces according to manufacturer's standard. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Powder Coating: Immediately after cleaning, apply manufacturer's standard two-coat finish consisting of epoxy primer and TGIC polyester topcoat to a minimum total dry film thickness of not less than 8 mils. Comply with coating manufacturer's written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 DECORATIVE FENCE INSTALLATION

- A. Install gate according to manufacturer's written instructions.

#### 3.3 GATE INSTALLATION

- A. Install gate according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

#### 3.4 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

END OF SECTION 323119