



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

**PROJECT MANUAL**

**WESTERN WAYNE SCHOOLS**

**PROJECT : WESTERN WAYNE SCHOOLS ADDITIONS & RENOVATIONS - BID PACKAGE #1**

**WESTERN WAYNE SCHOOLS**

**205 E. PARKWAY DRIVE**

**CAMBRIDGE CITY, INDIANA**

**DATE: 01-06-2025**

**PREPARED BY:**

**GMB**

**END OF SECTION**



## SECTION 00 01 02 - PROJECT INFORMATION

### PART 1 GENERAL

#### 1.1 PROJECT IDENTIFICATION

- A. Project Name: 5-6394 Western Wayne Schools Additions & Renovations - Bid Package #1, located at: 205 E. Parkway Dr. Cambridge City, IN 47327.
- B. Architect's Project Number: 5-6394
- C. The Owner, hereinafter referred to as Owner: Western Wayne Schools
  - 1. Sales Tax Exemption Number: to be provided to awarded General Contractor.

#### 1.2 NOTICE TO PROSPECTIVE BIDDERS

- A. These documents constitute an Invitation to Bid to General Contractors for the construction of the project described below.

#### 1.3 PROJECT DESCRIPTION

- A. Summary Project Description: The interior renovation and exterior additions to the existing gymnasium and adjacent spaces. The interior renovation consists of demolishing the existing locker and toilet rooms to create new locker rooms, restrooms, and training spaces. The new additions include new vestibules, lobby, concessions, officials locker room, and office spaces.
- B. Contract Terms: Lump sum (fixed price, stipulated sum)
- C. Final completion date is critical due to requirements of Owner's operations. Therefore contract will include liquidated damages of \$3,000 per day past final completion date.

#### 1.4 PROCUREMENT TIMETABLE

- A. Bid Documents Available: 01-07-2025.
- B. Pre-Bid Conference: 01-14-2025 9 A.M. at Project Site meet at door #33.
- C. Last Request for Substitution Due: 01-17-2025.
- D. Last Request for Information Due: 01-17-2025.
- E. Bid Due Date: 01-28-2025, before 2 PM local time.
- F. Bid Opening: Immediately after specified closing time.
- G. Notice to Proceed: Within 7 days after appropriate action by the Board.
- H. Bids May Not Be Withdrawn Until: 60 days after due date.
- I. Contract Time: To be stated in bid documents. Refer to Phasing Plan.
- J. The Owner reserves the right to change the schedule or terminate the entire procurement process at any time.

#### 1.5 PROCUREMENT DOCUMENTS

- A. Availability of Documents: Complete sets of procurement documents may be obtained:
  - 1. In electronic PDF format online at Eastern Engineering Plan Room. At the following address: [www.easternengineering.com]. (765) 284-3119
- B. Documents may be viewed at Administration Office 215 E. Parkway Drive Cambridge City, IN 47327, Door #33.

#### 1.6 BID SECURITY

- A. Bids shall be accompanied by a security deposit as follows:
  - 1. Bid Bond of a sum no less than 5 percent of the Bid Amount on AIA A310 Bid Bond Form.



**PART 2 PRODUCTS (NOT USED)**  
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**END OF SECTION**

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## **SECTION 00 01 15 - LIST OF DRAWING SHEETS**

### **1.1 LIST OF DRAWING SHEETS**

- A. The drawings include the Contract Drawings and other drawings listed in the Table of Contents of the separately bound set titled 5-6394 Western Wayne Schools Additions & Renovations - Bid Package #1, along with any modifications made by subsequent Addenda and Contract changes.

**END OF SECTION**



## SECTION 00 21 13 - INSTRUCTIONS TO BIDDERS

### SUMMARY

#### 1.1 THE INSTRUCTIONS IN THIS DOCUMENT SUPPLEMENT AIA A701, INSTRUCTIONS TO BIDDERS.

#### 1.2 RELATED DOCUMENTS

- A. Document 00 41 00 - Bid Form.
- B. Document 00 41 01 - Form 96.
- C. Document 00 43 36 - Proposed Subcontractors Form.

### INVITATION

#### 2.1 BID SUBMISSION

- A. Bids signed and under seal, executed, and dated will be received at the School Administration Office at 215 E. Parkway Drive Cambridge City, 47327, Door #33 before 2:00 p.m. local standard time on 01/28/2025.
- B. The Bid, bid security, and other documents required to be submitted with the Bid shall be enclosed in a sealed opaque envelope. The envelope shall be addressed to the party indicated below and shall be identified with the Project name, and the Bidder's name and address. If the Bid is sent by mail, the sealed envelope shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof.
  - 1. Western Wayne Schools
  - 2. Superintendent of Schools
  - 3. Andy Strover
  - 4. 215 E. Parkway Drive
  - 5. Cambridge City, 47327
  - 6. Door #33
- C. Offers submitted after the above time will be returned to the bidder unopened.
- D. Offers will be opened publicly immediately after the time for receipt of bids, and forwarded for appropriate action by the Board. All interested parties are invited to attend public bid opening.

#### 2.2 INTENT

- A. The intent of this Bid request is to obtain an offer to perform work for a single Prime Contract to complete project named 5-6394 Western Wayne Schools Additions & Renovations - Bid Package #1 for a Stipulated Sum contract, in accordance with Contract Documents.

#### 2.3 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS

- A. Work of this proposed Contract comprises building construction, including general construction Work.
- B. Project Location:
  - 205 E. Parkway Dr.
  - Cambridge City, Indiana 47327.

#### 2.4 CONTRACT TIME

- A. Identified Contract Time in the bid documents. Refer to Phasing Plan. Final Completion date is critical due to requirements of Owner's operations. Therefore contract will include liquidated damages of \$3,000 per day past completions dates per Phasing Plan.

### BID DOCUMENTS AND CONTRACT DOCUMENTS

#### 3.1 DEFINITIONS

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

### **3.2 CONTRACT DOCUMENTS IDENTIFICATION**

- A. Contract Documents are identified as Owner's Project Number 5-6394, as prepared by Architect, and with contents as identified in the Project Manual.

### **3.3 AVAILABILITY**

- A. Bid documents may be obtained in Electronic PDF format online at Eastern Engineering Plan Room [www.easternengineering.com](http://www.easternengineering.com) (765) 284-3119.

### **3.4 EXAMINATION**

- A. Bid Documents may be viewed at the office of Owner which is located at Administration Office 215 E. Parkway Drive Cambridge City, 46327, Door #33.
- B. Upon receipt of Bid Documents verify that documents are complete. Notify Architect should the documents be incomplete.
- C. Immediately notify Architect upon finding discrepancies or omissions in the Bid Documents.

### **3.5 INQUIRIES/ADDENDA**

- A. Direct questions to Architect, email; [dawnk@gmb.com](mailto:dawnk@gmb.com) and [amperc@gmb.com](mailto:amperc@gmb.com).
- B. Addenda may be issued during the bidding period. All Addenda become part of Contract Documents. Include resultant costs in the Bid Amount.
- C. Clarifications requested by bidders must be in writing no later than 01-17-2025. The reply will be in the form of an Addendum.

### **3.6 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTIONS**

- A. General Requirements for Substitution Requests:
  - 1. Project Manual establishes standards for products, assemblies, and systems.
  - 2. Provide sufficient information to determine acceptability of proposed substitutions.
  - 3. Provide complete information on required revisions to other work to accommodate each proposed substitution.
- B. Substitution Request Time Restrictions:
  - 1. Where the Bid Documents stipulate a particular product, substitutions will be considered:
    - a. Requests submitted in writing by bidders no later than 01-17-2025
- C. Review and Acceptance of Request:
  - 1. Architect may approve the proposed substitution and will issue an Addendum.
- D. See Section 01 25 00 - Substitution Procedures for additional requirements.

## **SITE ASSESSMENT**

### **4.1 SITE EXAMINATION**

- A. Examine the project site before submitting a bid.

### **4.2 PREBID CONFERENCE**

- A. A mandatory bidders conference has been scheduled for 9:00 a.m. on the 14th day of January at the location of project site at door #33.

## **QUALIFICATIONS**

### **5.1 EVIDENCE OF QUALIFICATIONS**

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

### **5.2 SUBCONTRACTORS/SUPPLIERS/OTHERS**

- A. Owner reserves the right to reject a proposed subcontractor for reasonable cause.
- B. Refer to General Conditions.

## **BID SUBMISSION**

### **6.1 BID INELIGIBILITY**

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

## **BID ENCLOSURES/REQUIREMENTS**

### **7.1 SECURITY DEPOSIT**

- A. Bids shall be accompanied by a security deposit as follows:
  - 1. Bid Bond of a sum no less than 5 percent of the Bid Amount on AIA A310 Bid Bond Form.
- B. Endorse the Bid Bond in the name of the Owner as obligee, signed and sealed by the principal (Contractor) and surety.
- C. The security deposit will be returned after delivery to the Owner of the required Performance and Payment Bond(s) by the accepted bidder.
- D. Include the cost of bid security in the Bid Amount.
- E. If no contract is awarded, all security deposits will be returned.

### **7.2 PERFORMANCE ASSURANCE**

- A. Accepted Bidder: Provide a Performance and a Labor and Material Payment bond.
- B. Include the cost of performance assurance bonds and Labor and Material Payment bond in the Bid Amount 100% of the Contract Sum.

### **7.3 INSURANCE**

- A. Provide an executed "Undertaking of Insurance" on a standard form provided by the insurance company stating their intention to provide insurance to the bidder in accordance with the insurance requirements of Contract Documents.
- B. Owners Insurance Requirements
  - 1. Worker's Compensation & Disability Requirements: Statutory
  - 2. Employer's Liability: \$100,000
  - 3. Comprehensive General Liability
    - a. Section 1. Bodily Injury: \$1,000,000 each occurrence, \$2,000,000 aggregate
    - b. Section 2. Property Damage: \$1,000,000 each occurrence
  - 4. Comprehensive Umbrella Liability: \$1,000,000 each occurrence, \$2,000,000 each aggregate
  - 5. Malpractice/Errors & omissions: \$1,000,000 per claim Insurance, \$2,000,000 each aggregate

### **7.4 BID FORM SIGNATURE**

- A. The Bid Form shall be signed by the bidder, as follows:
  - 1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature.
  - 2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature.



3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and secretary of the company, or the president/secretary/treasurer of the company, a copy of the by-law resolution of their board of directors authorizing them to do so, must also be submitted with the Bid Form in the bid envelope.
4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

#### **7.5 ADDITIONAL BID INFORMATION**

- A. All bidders will be requested to complete the Supplements To Bid Forms.
- B. Submit the following Supplements concurrent with bid submission:
  1. Form 96.
- C. Submit the following Supplements 48 hours after bid submission:
  1. Document 00 43 36 - Proposed Subcontractors Form: Include the names of all other Subcontractors not previously requested on the bid form and the portions of the Work they will perform.

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

##### **8.1 DURATION OF OFFER**

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

##### **8.2 ACCEPTANCE OF OFFER**

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

**END OF SECTION**





## **SECTION 00 31 00 - AVAILABLE PROJECT INFORMATION**

### **PART 1 GENERAL**

#### **1.1 EXISTING CONDITIONS**

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:
- B. Site Survey: Entitled Boundary & Topographic Survey Lincoln High School/Middle School Campus, dated 9/30/2024.
  - 1. Original copy is available for inspection at Owner's offices during normal business hours.
  - 2. Will be provided to awarded contractor.

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

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

**END OF SECTION**



**SECTION 00 41 00 - BID FORM**

**THE PROJECT AND THE PARTIES**

**1.1 TO:**

- A. Owner  
Western Wayne Schools  
215 E. Parkway Drive  
Cambridge City, Indiana 47327

**1.2 FOR:**

- A. Project: 5-6394 Western Wayne Schools Additions & Renovations - Bid Package #1
- B. Owner's Project Number: 5-6394  
205 E. Parkway Dr.  
Cambridge City, Indiana 47327

**1.3 DATE: \_\_\_\_\_ (BIDDER TO ENTER DATE)**

**1.4 SUBMITTED BY: (BIDDER TO ENTER NAME AND ADDRESS)**

- A. Bidder's Full Name \_\_\_\_\_
  - 1. Address \_\_\_\_\_
  - 2. City, State, Zip \_\_\_\_\_

**1.5 OFFER**

- A. Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Bid Documents for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:
- B. \_\_\_\_\_ dollars  
(\$ \_\_\_\_\_), in lawful money of the United States of America.
- C. We have included the required security deposit Bid Bond as required by the Instruction to Bidders.
- D. We have included the required performance assurance bonds and Labor and Material Payment Bond in the Bid Amount as required by the Instructions to Bidders.
  - 1. The cost of the required performance assurance bonds and Labor and Material Payment Bond is included in the Sum total on line 1.5B and seperated below for accounting purposes \_\_\_\_\_ dollars (\$ \_\_\_\_\_), in lawful money of the United States of America.
- E. All Cash and Contingency Allowances described in Section 01 21 00 - Allowances are included in the Bid Sum.

**1.6 ACCEPTANCE**

- A. This offer shall be open to acceptance and is irrevocable for sixty days from the bid closing date.
- B. If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

**1.7 CONTRACT TIME**

- A. If this Bid is accepted, we will:
- B. Complete the Work by identified Contract Time in the bid documents. Refer to Phasing Plan. Final Completion date is critical due to requirements of Owner's operations. Therefore contract will include liquidated damages of \$3,000 per day past completions dates per Phasing Plan..



**1.8 CHANGES TO THE WORK**

- A. When Architect establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will not exceed:
  - 1. 5% percent overhead and profit on the net cost of our own Work;
  - 2. 10% percent on the cost of work done by any Subcontractor.

**1.9 ADDENDA**

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

**1.10 MAJOR SUBCONTRACTOR LIST**

- A. Include the names of all Subcontractors requested for the portions of the Work they will perform.
  - 1. Electrical Sub-Contractor \_\_\_\_\_
  - 2. Plumbing Sub-Contractor \_\_\_\_\_
  - 3. HVAC Sub-Contractor \_\_\_\_\_
  - 4. Tempurature Controls Sub-Contractor \_\_\_\_\_
  - 5. Masonry Sub-Contractor \_\_\_\_\_
  - 6. Concrete Sub-Contractor \_\_\_\_\_
  - 7. Painting Sub-Contractor \_\_\_\_\_
  - 8. Flooring Sub-Contractor \_\_\_\_\_

**1.11 BID FORM SUPPLEMENTS**

- A. The following Supplements are attached to this Bid Form and are considered an integral part of this Bid Form:
  - 1. Document 00 41 01 - Form 96
- B. We agree to submit the following Supplements to Bid Forms within 48 hours after submission of this bid for additional bid information:
  - 1. Document 00 43 36 - Proposed Subcontractors Form: Include the names of all other Subcontractors not previously requested on the bid form and the portions of the Work they will perform.

**1.12 BID FORM SIGNATURE(S)**

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

**END OF SECTION**



# CONTRACTOR'S BID FOR PUBLIC WORK - FORM 96

State Form 52414 (R / 9-10) / Form 96 (Revised 2010)

Prescribed by State Board of Accounts

## PART I

*(To be completed for all bids. Please type or print)*

Date (month, day, year): \_\_\_\_\_

1. Governmental Unit (Owner): \_\_\_\_\_

2. County : \_\_\_\_\_

3. Bidder (Firm): \_\_\_\_\_

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

City/State/ZIPcode: \_\_\_\_\_

4. Telephone Number: \_\_\_\_\_

5. Agent of Bidder (if applicable): \_\_\_\_\_

Pursuant to notices given, the undersigned offers to furnish labor and/or material necessary to complete the public works project of \_\_\_\_\_

(Governmental Unit) in accordance with plans and specifications prepared by \_\_\_\_\_

\_\_\_\_\_ and dated \_\_\_\_\_ for the sum of  
\_\_\_\_\_ \$ \_\_\_\_\_

The undersigned further agrees to furnish a bond or certified check with this bid for an amount specified in the notice of the letting. If alternative bids apply, the undersigned submits a proposal for each in accordance with the notice. Any addendums attached will be specifically referenced at the applicable page.

If additional units of material included in the contract are needed, the cost of units must be the same as that shown in the original contract if accepted by the governmental unit. If the bid is to be awarded on a unit basis, the itemization of the units shall be shown on a separate attachment.

The contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee, or applicant for employment, to be employed in the performance of this contract, with respect to any matter directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

### CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS *(If applicable)*

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory obligation to use steel products made in the United States (I.C. 5-16-8-2). I hereby certify that I and all subcontractors employed by me for this project will use U.S. steel products on this project if awarded. I understand that violations hereunder may result in forfeiture of contractual payments.

ACCEPTANCE

The above bid is accepted this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, subject to the following conditions: \_\_\_\_\_

Contracting Authority Members:

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

PART II

(For projects of \$100,000 or more – IC 36-1-12-4)

Governmental Unit: \_\_\_\_\_

Bidder (Firm) \_\_\_\_\_

Date (month, day, year): \_\_\_\_\_

These statements to be submitted under oath by each bidder with and as a part of his bid. Attach additional pages for each section as needed.

SECTION I EXPERIENCE QUESTIONNAIRE

- 1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

Table with 4 columns: Contract Amount, Class of Work, Completion Date, Name and Address of Owner. Contains 4 empty rows.

- 2. What public works projects are now in process of construction by your organization?

Table with 4 columns: Contract Amount, Class of Work, Expected Completion Date, Name and Address of Owner. Contains 4 empty rows.

3. Have you ever failed to complete any work awarded to you? \_\_\_\_\_ If so, where and why?

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4. List references from private firms for which you have performed work.

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### SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed work. *(Examples could include a narrative of when you could begin work, complete the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)*

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2. Please list the names and addresses of all subcontractors *(i.e. persons or firms outside your own firm who have performed part of the work)* that you have used on public works projects during the past five (5) years along with a brief description of the work done by each subcontractor.

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3. If you intend to sublet any portion of the work, state the name and address of each subcontractor, equipment to be used by the subcontractor, and whether you will require a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval. Until the completion of the proposed project, you are under a continuing obligation to immediately notify the governmental unit in the event that you subsequently determine that you will use a subcontractor on the proposed project.

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4. What equipment do you have available to use for the proposed project? Any equipment to be used by subcontractors may also be required to be listed by the governmental unit.

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5. Have you entered into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? If not, please explain the rationale used which would corroborate the prices listed.

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### SECTION III CONTRACTOR'S FINANCIAL STATEMENT

Attachment of bidder's financial statement is mandatory. Any bid submitted without said financial statement as required by statute shall thereby be rendered invalid. The financial statement provided hereunder to the governing body awarding the contract must be specific enough in detail so that said governing body can make a proper determination of the bidder's capability for completing the project if awarded.







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**BID OF**

\_\_\_\_\_ (Contractor)

\_\_\_\_\_ (Address)

\_\_\_\_\_

**FOR  
PUBLIC WORKS PROJECTS  
OF**

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

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Filed \_\_\_\_\_, \_\_\_\_\_

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Action taken \_\_\_\_\_

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





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

**PARTICULARS**

- 1.1 HERewith IS THE LIST OF SUBCONTRACTORS REFERENCED IN THE BID SUBMITTED BY:
- 1.2 (BIDDER) \_\_\_\_\_
- 1.3 TO (OWNER ): WESTERN WAYNE SCHOOLS
- 1.4 DATED \_\_\_\_\_ AND WHICH IS AN INTEGRAL PART OF THE BID FORM.
- 1.5 THE FOLLOWING WORK WILL BE PERFORMED (OR PROVIDED) BY SUBCONTRACTORS AND COORDINATED BY US:

**LIST OF ALL OTHER SUBCONTRACTORS NOT PREVIOUSLY REQUESTED ON THE BID FORM.**

**WORK SUBJECT SUBCONTRACTOR NAME**

- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
- D. \_\_\_\_\_
- E. \_\_\_\_\_
- F. \_\_\_\_\_
- G. \_\_\_\_\_
- H. \_\_\_\_\_
- I. \_\_\_\_\_
- J. \_\_\_\_\_
- K. \_\_\_\_\_
- L. \_\_\_\_\_
- M. \_\_\_\_\_
- N. \_\_\_\_\_
- O. \_\_\_\_\_
- P. \_\_\_\_\_
- Q. \_\_\_\_\_
- R. \_\_\_\_\_
- S. \_\_\_\_\_
- T. \_\_\_\_\_
- U. \_\_\_\_\_
- V. \_\_\_\_\_
- W. \_\_\_\_\_
- X. \_\_\_\_\_
- Y. \_\_\_\_\_
- Z. \_\_\_\_\_

**END OF SECTION**



## SECTION 01 00 01 - ELECTRONIC MODEL/DRAWING FILE EXCHANGE AGREEMENT

### PART 1 GENERAL

#### 1.1 INFORMATION AVAILABILITY

- A. Electronic files will not be supplied during the bidding phase of a project. Information will only be available to the awarded contractors upon completion of this form.

#### 1.2 DISCLAIMER FOR USE OF ELECTRONIC FILES

- A. The documents contained in the transmitted electronic files are GMB Architecture + Engineering's instruments of service and are dynamic in nature and subject to change, sometimes daily. They are transmitted for use with the understanding that they may in no way be implied to be the actual Contract Documents for the referenced project.
- B. We provide electronic files for your convenience and approved uses for the referenced project.
- C. The undersigned party of \_\_\_\_\_ (hereinafter referred to as Company) hereby accepts electronic model/drawing files as prepared for the referenced project by GMB Architecture + Engineering. These files may include multiple models, including but not limited to architectural, civil, mechanical, plumbing, electrical and structural models/drawings for Company's use in preparing submittals, coordination or fabrication drawings.
- D. Use of these files is subject to the following terms and conditions:
1. We make no representation as to the compatibility of these files with your hardware or your software. Building Information Models (BIM) will be delivered in Navisworks or Revit, Site/Civil layouts will be delivered in AutoCAD, these files will be delivered in version(s) in which they were originally created in. GMB Architecture + Engineering will not take responsibility to upgrade or downgrade electronic models/drawing files, or to export to alternative file formats unless listed below.
  2. GMB will transmit TIN surface data for site/civil work in the Extensible Markup Language (XML) format. BIM models can be exported to Navisworks or as 2D base plans to AutoCAD (DWG) format upon request.
    - a. Data contained on these electronic files are part of our instruments of service, are copyrighted and shall not be used for any purpose other than as a convenience in the preparation of submittals, coordination or fabrication drawings (or other approved uses) for the referenced project only. These electronic files are provided for the Company's convenience only, is not a Contract Document and does not relieve the Contractor from the requirements of the Contract Documents. Any use by Company will be at your sole risk and without liability or legal exposure to us. The Company agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or sub consultants that may arise out of or in connection with your use of the electronic files.
    - b. This information is provided for the express use of Company and is not to be distributed or otherwise reproduced without the express written consent of GMB Architecture + Engineering. and the re-submittal of this agreement.
    - c. Where building information modeling (BIM) is being used GMB Architecture + Engineering models are generally created to a LOD 250-300. Not all elements may be modeled or represented in 3D space. Company is responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project.



- d. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by GMB and the electronic files, the signed or sealed hard-copy construction documents shall govern. Company is responsible for determining if any conflict exists. By The Company's use of these electronic files, The Company is not relieved of obligation to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate their work with that of other contractors for the project.
  - e. The Company shall, to the fullest extent permitted by law, indemnify and hold GMB harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from their use of these electronic files.
  - f. Information presented on the electronic files are dynamic in nature, can be modified, unintentionally or otherwise, GMB Architecture + Engineering takes no responsibility for the accuracy of information provided, or for changes made after issue to Company, who assumes all risks associated with the use of these Models/Drawing files.
  - g. All direct and indirect references to GMB Architecture + Engineering as the preparer of these models/drawing files shall be removed from the models/drawing files by Company.
  - h. Record Models/Drawing files have been generated using information submitted to GMB by the Contractors. The information and update of the construction documents is based on marked-up drawings of the contractors' addendums, bulletins, change orders and field directives which may or may not have been verified by GMB.
  - i. Return Submittals to GMB shall include a method for identifying where modifications have occurred to the Drawings/Model, such as a change in line type, clouding, or other method deemed acceptable to GMB Architecture + Engineering. See specification section 01 33 00 for shop drawing submittal requirements.
  - j. Two-Dimensional drawing files are provided free of charge so long as there are not excessive requests from the contractor. Three Dimensional Electronic models are subject to processing fees, the fee schedule is attached. Payment, if required, for modeled information is required prior to the release of electronic documents. Under no circumstances shall delivery of the electronic files for use by you be deemed a sale by us, and we make no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall we be liable for any loss of profit or any consequential damages as a result of your use or reuse of these electronic files. GMB will prepare the electronic files for transmission to the Company within 4-5 business days after signed request is received.
  - k. The information provided in the BIM/CAD files is only diagrammatic, BIM information may be modeled in multiple models, it is the Company's responsibility to request and cross reference all relevant models. Specifications require that the work and coordinated shop drawings reflect actual field verified conditions with actual equipment/duct sizes, utility locations, and related site/project conditions.
  - l. Electronic models will be delivered as is and may or may not include all items including but not limited to sheets, schedules, details, legends, annotations, etc. .
- E. Prepared Electronic Media will be held for 3 business days from the time the file(s) have been sent from GMB to the company, you agree to the contents of this notice and that the files have been received and opened as requested.

**1.3 ELECTRONIC MEDIA PREPARATION FEE SCHEDULE:**

- |   |           |
|---|-----------|
| A. Civil Model with proposed TIN:       | No Charge |
| B. 2D AutoCAD (DWG) per Drawing export: | No Charge |







## SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Procedures for preparation and submittal of application for final payment.

#### 1.2 RELATED REQUIREMENTS

- A. Section 00 50 00 - Contracting Forms and Supplements: Forms to be used.
- B. Section 01 21 00 - Allowances: Payment procedures relating to allowances.

#### 1.3 SCHEDULE OF VALUES

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

#### 1.4 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at monthly intervals.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Execute certification by signature of authorized officer.
- D. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- E. Payment Terms: 31 days after pay request approval.
- F. Submit one electronic and three hard-copies of each Application for Payment.

#### 1.5 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days.
- C. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
  - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
  - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
  - 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
  - 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- D. Substantiation of Costs: Provide full information required for evaluation.
  - 1. On request, provide the following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.



2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
    - c. Time records and wage rates paid.
  3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- E. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- F. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- G. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- H. Promptly enter changes in Project Record Documents.

#### **1.6 APPLICATION FOR FINAL PAYMENT**

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

**END OF SECTION**



## SECTION 01 21 00 - ALLOWANCES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Contingency allowance.

#### 1.2 CONTINGENCY ALLOWANCE

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.

#### 1.3 ALLOWANCES SCHEDULE

- A. General Construction: Include the stipulated sum of \$300,000 for purchase and delivery of Unknown at time of Bid.
- B. Door Access Allowance: Include the stipulated sum of \$50,000 for purchase and delivery of [Unknown at time of Bid].
- C. Fire Alarm Allowance: Include the stipulated sum of \$50,000 for purchase and delivery of [Unknown at time of Bid].

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION - NOT USED

END OF SECTION



## SECTION 01 25 00 - SUBSTITUTION PROCEDURES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

#### 1.2 RELATED REQUIREMENTS

- A. Section 00 21 13 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 01 30 00 Administrative Requirements

#### 1.3 DEFINITIONS

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

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.1 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
  - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
  - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
  - 1. Note explicitly any non-compliant characteristics.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  - 1. No specific form is required. Contractor's Substitution Request documentation must include the following:
    - a. Project Information:
      - 1) Official project name and number, and any additional required identifiers established in Contract Documents.
      - 2) Owner's, Architect's, and Contractor's names.
    - b. Substitution Request Information:
      - 1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
      - 2) Indication of whether the substitution is for cause or convenience.
      - 3) Issue date.

- 4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
  - 5) Description of Substitution.
  - 6) Reason why the specified item cannot be provided.
  - 7) Differences between proposed substitution and specified item.
  - 8) Description of how proposed substitution affects other parts of work.
- c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
- 1) Physical characteristics.
  - 2) In-service performance.
  - 3) Expected durability.
  - 4) Visual effect.
  - 5) Sustainable design features.
  - 6) Warranties.
  - 7) Other salient features and requirements.
  - 8) Include, as appropriate or requested, the following types of documentation:
    - (a) Product Data:
    - (b) Samples.
    - (c) Certificates, test, reports or similar qualification data.
    - (d) Drawings, when required to show impact on adjacent construction elements.
- d. Impact of Substitution:
- 1) Savings to Owner for accepting substitution.
  - 2) Change to Contract Time due to accepting substitution.
- D. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

### **3.2 SUBSTITUTION PROCEDURES DURING PROCUREMENT**

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

### **3.3 SUBSTITUTION PROCEDURES DURING CONSTRUCTION**

- A. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- B. Submit request for Substitution for Convenience within 14 days of discovery of its potential advantage to the project, but not later than 30 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
  2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
  3. Bear the costs engendered by proposed substitution of:
    - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.

### **3.4 RESOLUTION**

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.





### **3.5 ACCEPTANCE**

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

### **3.6 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

**END OF SECTION**



## SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

### PART 1 GENERAL

#### 1.1 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
  - 1. Requests for Interpretation (RFI).
  - 2. Shop drawings, product data, and samples.
  - 3. Test and inspection reports.
  - 4. Design data.
  - 5. Manufacturer's instructions and field reports.
  - 6. Applications for payment and change order requests.
  - 7. Progress schedules.
  - 8. Coordination drawings.
  - 9. Correction Punch List and Final Correction Punch List for Substantial Completion.
  - 10. Closeout submittals.

### PART 2 PRODUCTS - NOT USED

### PART 3 EXECUTION

#### 3.1 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
  - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
  - 2. Contractor and Architect are required to use this service.
  - 3. It is Contractor's responsibility to submit documents in allowable format.
  - 4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
  - 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, [www.adobe.com](http://www.adobe.com), or Bluebeam PDF Revu, [www.bluebeam.com](http://www.bluebeam.com)), unless such software capability is provided by the service provider.
  - 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
  - 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Submittal Service: The selected service is:
- C. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

### 3.2 PRECONSTRUCTION MEETING

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

### 3.3 PROGRESS MEETINGS

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

### 3.4 REQUESTS FOR INTERPRETATION (RFI)

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

1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
  1. Prepare a separate RFI for each specific item.
    - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    - b. Do not forward requests which solely require internal coordination between subcontractors.
  2. Prepare using software provided by the Electronic Document Submittal Service.
  3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
  1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
  2. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
    - a. Approval of submittals (use procedures specified elsewhere in this section).
    - b. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
    - c. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
  3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
  1. Official Project name and number, and any additional required identifiers established in Contract Documents.
  2. Owner's, Architect's, and Contractor's names.
  3. Discrete and consecutive RFI number, and descriptive subject/title.
  4. Issue date, and requested reply date.
  5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
  6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
  7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

### **3.5 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  1. Product data.
  2. Shop drawings.

3. Samples for selection.
  4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

### **3.6 SUBMITTALS FOR INFORMATION**

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

### **3.7 SUBMITTALS FOR PROJECT CLOSEOUT**

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
1. Project record documents.
  2. Operation and maintenance data.
  3. Warranties.
  4. Bonds.
  5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

### **3.8 NUMBER OF COPIES OF SUBMITTALS**

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. After review, produce duplicates.
  2. Retained samples will not be returned to Contractor unless specifically so stated.

### **3.9 SUBMITTAL PROCEDURES**

- A. General Requirements:
1. Use a single transmittal for related items.
  2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
  3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
  4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.

- a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
  5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
    - a. Upload submittals in electronic form to Electronic Document Submittal Service website.
  6. Schedule submittals to expedite the Project, and coordinate submission of related items.
    - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
    - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
    - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
  7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
  8. Provide space for Contractor and Architect review stamps.
  9. When revised for resubmission, identify all changes made since previous submission.
  10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
  11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
  12. Submittals not requested will be recognized, and will be returned "Not Reviewed",
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
  2. Collect required information into a single submittal.
  3. Submit concurrently with related shop drawing submittal.
  4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
  2. Do not reproduce Contract Documents to create shop drawings.
  3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
  2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
  3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

### 3.10 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
  1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
  1. Authorizing purchasing, fabrication, delivery, and installation:
    - a. "Approved", or language with same legal meaning.



- b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
    - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
  - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
  - 2. Not Authorizing fabrication, delivery, and installation:
- E. Architect's and consultants' actions on items submitted for information:
- 1. Items for which no action was taken:
    - a. "Received" - to notify the Contractor that the submittal has been received for record only.
  - 2. Items for which action was taken:
    - a. "Reviewed" - no further action is required from Contractor.

**END OF SECTION**



## SECTION 01 45 33 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

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

#### 1.2 RELATED REQUIREMENTS

- A. Document 00 31 00 - Available Project Information: Soil investigation data.

#### 1.3 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authority having jurisdiction.
- B. IAS: International Accreditation Service, Inc.
- C. NIST: National Institute of Standards and Technology.

#### 1.4 DEFINITIONS

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

#### 1.5 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary.
- B. AISC 341 - Seismic Provisions for Structural Steel Buildings.
- C. AISC 360 - Specification for Structural Steel Buildings.
- D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- F. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
- G. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- H. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete.
- I. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- J. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

- K. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- M. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
- N. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars.
- O. IAS AC89 - Accreditation Criteria for Testing Laboratories.
- P. IAS AC291 - Accreditation Criteria for Special Inspection Agencies AC291.
- Q. ICC (IBC)-2015 - International Building Code.
- R. SDI (QA/QC) - Standard for Quality Control and Quality Assurance for Installation of Steel Deck.
- S. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders.
- T. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

## 1.6 SUBMITTALS

- A. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
  - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
  - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
  - 4. Submit documentation that Special Inspection Agency is accredited by IAS according to IAS AC291.
- B. Testing Agency Qualifications: Prior to the start of work, the Testing Agency is required to:
  - 1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
  - 3. Submit certification that Testing Agency is acceptable to AHJ.
- C. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to the AHJ.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of Special Inspector.
    - d. Date and time of special inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of special inspection.
    - h. Date of special inspection.
    - i. Results of special inspection.
    - j. Compliance with Contract Documents.
- D. Test Reports: After each test or inspection, promptly submit at least two copies of report; one to Architect and one to AHJ.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.

- c. Name of inspector.
- d. Date and time of sampling or inspection.
- e. Identification of product and specifications section.
- f. Location in the Project.
- g. Type of test or inspection.
- h. Date of test or inspection.
- i. Results of test or inspection.
- j. Compliance with Contract Documents.

### **1.7 SPECIAL INSPECTION AGENCY**

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

### **1.8 TESTING AND INSPECTION AGENCIES**

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

### **1.9 QUALITY ASSURANCE**

- A. Special Inspection Agency Qualifications:
  - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
  - 2. Accredited by IAS according to IAS AC291.
- B. Testing Agency Qualifications:
  - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
  - 2. Accredited by IAS according to IAS AC89.

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

## **PART 3 EXECUTION**

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

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

### **3.2 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION**

- A. Structural Steel: Comply with quality assurance inspection requirements of ICC (IBC)-2015.
- B. Cold-Formed Steel Deck: Comply with quality assurance inspection requirements of SDI (QA/QC).
- C. Open-Web Joists and Joist Girders: Comply with requirements of ICC (IBC), Table 1705.2.3.
  - 1. End Connections - Welding or Bolted: Comply with requirements of SJI 100; periodic.
  - 2. Bridging - Horizontal or Diagonal:

- a. Standard Bridging: Comply with requirements of SJI 100; periodic.
  - b. Bridging That Differs From the SJI Specifications: Periodic inspection.
- D. Cold-Formed Steel Trusses Spanning 60 feet or Greater: Special Inspector is required to verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.
- E. High-Strength Bolt, Nut and Washer Material:
1. Verify identification markings comply with ASTM standards specified in the approved contract and to AISC 360, Section A3.3; periodic.
  2. Submit manufacturer's certificates of compliance; periodic.
- F. High-Strength Bolting Installation: Verify items listed below comply with AISC 360, Section M2.5.
1. Snug tight joints; periodic.
  2. Pretensioned and slip-critical joints with matchmarking, twist-off bolt or direct tension indicator method of installation; periodic.
- G. Structural Steel and Cold Formed Steel Deck Material:
1. Structural Steel: Verify identification markings comply with AISC 360, Section M3.5; periodic.
  2. Other Steel: Verify identification markings comply with ASTM standards specified in the approved Contract Documents; periodic.
  3. Submit manufacturer's certificates of compliance and test reports; periodic.
- H. Welding:
1. Structural Steel and Cold Formed Steel Deck:
    - a. Complete and Partial Joint Penetration Groove Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
    - b. Multipass Fillet Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
    - c. Single Pass Fillet Welds Less than 5/16 inch Wide: Verify compliance with AWS D1.1/D1.1M; periodic.
    - d. Plug and Slot Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
    - e. Single Pass Fillet Welds 5/16 inch or Greater: Verify compliance with AWS D1.1/D1.1M; continuous.
    - f. Floor and Roof Deck Welds: Verify compliance with AWS D1.3/D1.3M; continuous.
  2. Reinforcing Steel: Verify items listed below comply with AWS D1.4/D1.4M and ACI CODE-318, Section 3.5.2.
    - a. Verification of weldability; periodic.
    - b. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames as well as where it is referenced in older codes. Elements of special structural walls of concrete and shear reinforcement; continuous.
    - c. Shear reinforcement; continuous.
    - d. Other reinforcing steel; periodic.
- I. Steel Frame Joint Details: Verify compliance with approved Contract Documents.
1. Details, bracing and stiffening; periodic.
  2. Member locations; periodic.
  3. Application of joint details at each connection; periodic.

### **3.3 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION**

- A. Reinforcement, Including Prestressing Tendons, and Verification of Placement: Verify compliance with ACI CODE-318, Chapters 20, 25.2, 25.3, 26.6.1-26.6.3; periodic.
- B. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved Contract Documents and ACI CODE-318, Sections 3.5 and 7.1 through 7.7; periodic.
- C. Reinforcing Bar Welding: Verify compliance with AWS D1.4/D1.4M and ACI CODE-318, 26.6.4; periodic.

1. Verify weldability of reinforcing bars other than those complying with ASTM A706/A706M; periodic.
  2. Inspect single-pass fillet welds, maximum 5/16 inch; periodic.
  3. Inspect all other welds; continuous.
- D. Reinforcing Steel Welding: Verify compliance with AWS D1.4/D1.4M and ACI CODE-318, Section 3.5.2; periodic.
- E. Anchors Cast in Concrete: Verify compliance with ACI CODE-318; periodic.
- F. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved Contract Documents and ACI CODE-318, Sections 8.1.3 and 21.2.8 prior to and during placement of concrete; continuous.
- G. Anchors Post-Installed in Hardened Concrete: Verify compliance with ACI CODE-318.
1. Adhesive Anchors: Verify horizontally or upwardly-inclined orientation installations resisting sustained tension loads - Section 17.8.2.4; continuous.
  2. Other Mechanical and Adhesive Anchors: Verify as per Chapter 17.8.2; periodic.
- H. Anchors Installed in Hardened Concrete: Verify compliance with ACI CODE-318, Sections 3.8.6, 8.1.3, and 21.2.8; continuous.
- I. Design Mix: Verify plastic concrete complies with the design mix in approved Contract Documents and with ACI CODE-318, Chapter 19, 16.4.3, 26.4.4; periodic.
- J. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M, and ACI CODE-318, Chapter 26.4.5, 26.12, and record the following, continuous:
1. Slump.
  2. Air content.
  3. Temperature of concrete.
- K. Specified Curing Temperature and Techniques: Verify compliance with ACI CODE-318, Chapter 26.4.7 through 26.4.9; periodic.
- L. Precast Concrete Members: Verify erection techniques and placement comply with approved Contract Documents and ACI CODE-318, Chapter 26.8; periodic.
- M. Precast Concrete Members: Verify erection techniques and placement comply with approved Contract Documents and ACI CODE-318, Chapter 16; periodic.
- N. Concrete Strength in Situ: Verify concrete strength complies with approved Contract Documents and ACI CODE-318, Chapter 26.10.2, for the following:
1. Beams and structural slabs, prior to removal of shores and forms; periodic.
- O. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI CODE-318, Chapter 26.10.1(b); periodic.
- P. Welding of Reinforcing Bars: Conduct special inspections and verify Special Inspector's qualifications in accordance with requirements of AWS D1.4/D1.4M.
- Q. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials comply with the quality standards of ACI CODE-318, the AHJ will require testing of materials in accordance with the appropriate standards and criteria in ACI CODE-318, Chapters 19 and 20.

### **3.4 SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION**

- A. Masonry Structures Subject to Special Inspection:
1. Masonry construction when required by the quality assurance program of TMS 402/602.
  2. Empirically designed masonry, glass unit masonry and masonry veneer in structures in Risk Category IV.
    - a. Perform inspections in accordance with Level B Quality Assurance.
  3. Engineered masonry in structures classified as "low hazard..." and "substantial hazard to human life in the event of failure".

- B. Verify each item below complies with approved Contract Documents and the applicable articles of TMS 402/602.
1. Inspections and Approvals:
    - a. Verify compliance with the required inspection provisions of the approved Contract Documents; periodic.
    - b. Verify approval of submittals required by Contract Documents; periodic.
  2. Compressive Strength of Masonry: Verify compressive strength of masonry units prior to start of construction unless specifically exempted by code; periodic.
  3. Slump Flow and Visual Stability Index (VSI): Verify compliance as self consolidating grout arrives on site; continuous.
  4. Joints and Accessories: When masonry construction begins, verify:
    - a. Proportions of site prepared mortar; periodic.
    - b. Construction of mortar joints; periodic.
    - c. Location of reinforcement, connectors, prestressing tendons, anchorages, etc; periodic.
  5. Structural Elements, Joints, Anchors, Protection: During masonry construction, verify:
    - a. Size and location of structural elements; periodic.
    - b. Type, size and location of anchors, including anchorage of masonry to structural members, frames or other construction; continuous.
    - c. Size, grade and type of reinforcement, anchor bolts and prestressing tendons and anchorages; periodic.
    - d. Welding of reinforcing bars; continuous.
    - e. Preparation, construction and protection of masonry against hot weather above 90 degrees F and cold weather below 40 degrees F; periodic.
  6. Grouting Preparation: Prior to grouting, verify:
    - a. Grout space is clean; continuous.
    - b. Correct placement of reinforcing, connectors, prestressing tendons and anchorages; continuous.
    - c. Correctly proportioned site prepared grouts and prestressing grout for bonded tendons; periodic.
    - d. Correctly constructed mortar joints; periodic.
  7. Preparation of Grout Specimens, Mortar Specimens and Prisms: Observe preparation of specimens; continuous.

### **3.5 SPECIAL INSPECTIONS FOR PREFABRICATED AND SITE-BUILT WOOD CONSTRUCTION**

- A. Metal Plate Connected Wood Trusses with Clear Span of 60 feet or More: Verify compliance of each item below with approved Contract Documents in general and with approved truss submittal package in particular.
1. Temporary restraint and bracing.
  2. Permanent individual truss member restraint and bracing.

### **3.6 SPECIAL INSPECTIONS FOR SOILS**

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

### **3.7 SPECIAL INSPECTIONS FOR VERTICAL MASONRY FOUNDATION ELEMENTS**

- A. Vertical Masonry Foundation Elements are subject to the same special inspection requirements listed in the "Special Inspections for Masonry Construction" Article of this section.

### **3.8 SPECIAL INSPECTIONS FOR WIND RESISTANCE**

- A. Structural Wood:
  - 1. Field gluing of components in the main wind force-resisting system; continuous.
  - 2. Nailing, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic.
- B. Cold-Formed Steel Light Frame Construction:
  - 1. Field welding; periodic.
  - 2. Screw attachment, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic
- C. Wind Resisting Components:
  - 1. Roof covering, roof deck, and floor framing connections; periodic.
  - 2. Exterior wall covering and wall connections to roof and floor diaphragms and framing; periodic.
- D. Structural Observations for Wind Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

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

- A. Special Inspection Agency shall:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified reference standards.
  - 3. Ascertain compliance of materials and products with requirements of Contract Documents.
  - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
  - 5. Perform additional tests and inspections required by Architect.
  - 6. Submit reports of all tests or inspections specified.
- B. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- C. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

### **3.10 TESTING AGENCY DUTIES AND RESPONSIBILITIES**

- A. Testing Agency Duties:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified standards.
  - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
  - 5. Perform additional tests and inspections required by Architect.
  - 6. Submit reports of all tests or inspections specified.
- B. Limits on Testing or Inspection Agency Authority:
  - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  - 2. Agency may not approve or accept any portion of the work.
  - 3. Agency may not assume any duties of Contractor.
  - 4. Agency has no authority to stop the work.
- C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.

- D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

### **3.11 CONTRACTOR DUTIES AND RESPONSIBILITIES**

- A. Contractor Responsibilities, General:
  - 1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
  - 2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
  - 3. Provide incidental labor and facilities:
    - a. To provide access to work to be tested or inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
    - c. To facilitate tests or inspections.
    - d. To provide storage and curing of test samples.
  - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
  - 5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- B. Contractor Responsibilities, Wind Force-Resisting System and Wind Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

**END OF SECTION**



## SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Temporary Controls: Barriers, enclosures, and fencing.
- B. Security requirements.
- C. Waste removal facilities and services.

#### 1.2 TEMPORARY UTILITIES

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

#### 1.3 BARRIERS

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

#### 1.4 FENCING

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

#### 1.5 EXTERIOR ENCLOSURES

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

#### 1.6 INTERIOR ENCLOSURES

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

#### 1.7 SECURITY

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

#### 1.8 VEHICULAR ACCESS AND PARKING

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.



## **1.9 WASTE REMOVAL**

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

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**

## SECTION 01 70 00 - EXECUTION AND CLOSEOUT REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- J. General requirements for maintenance service.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- B. Section 01 50 00 - Temporary Facilities and Controls: Temporary exterior enclosures.
- C. Section 01 50 00 - Temporary Facilities and Controls: Temporary interior partitions.
- D. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- E. Section 01 79 00 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
- F. Section 02 41 00 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.
- G. Section 07 84 00 - Firestopping.

#### 1.3 REFERENCE STANDARDS

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

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
  - 1. On request, submit documentation verifying accuracy of survey work.
  - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
  - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.

## 1.5 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

## 1.6 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- H. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

## 1.7 COORDINATION

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

## PART 2 PRODUCTS

### 2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 PREPARATION**

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

#### **3.3 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

#### **3.4 LAYING OUT THE WORK**

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

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

### **3.5 GENERAL INSTALLATION REQUIREMENTS**

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

### **3.6 ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  1. Verify that construction and utility arrangements are as indicated.
  2. Report discrepancies to Architect before disturbing existing installation.
  3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
  1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
  1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
  2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
  1. Remove items indicated on drawings.
  2. Relocate items indicated on drawings.
  3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
  1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.

3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    - b. Provide temporary connections as required to maintain existing systems in service.
  4. Verify that abandoned services serve only abandoned facilities.
  5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
  2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
  3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
  2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

### **3.7 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
  1. Complete the work.
  2. Fit products together to integrate with other work.
  3. Provide openings for penetration of mechanical, electrical, and other services.
  4. Match work that has been cut to adjacent work.
  5. Repair areas adjacent to cuts to required condition.
  6. Repair new work damaged by subsequent work.
  7. Remove samples of installed work for testing when requested.
  8. Remove and replace defective and non-complying work.

- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- G. Restore work with new products in accordance with requirements of Contract Documents.
- H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.
- J. Patching:
  - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
  - 2. Match color, texture, and appearance.
  - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### **3.8 PROGRESS CLEANING**

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

### **3.9 PROTECTION OF INSTALLED WORK**

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

### **3.10 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.



- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.11 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01 79 00 - Demonstration and Training.
- B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

### **3.12 ADJUSTING**

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

### **3.13 FINAL CLEANING**

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

### **3.14 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

### **3.15 MAINTENANCE**

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

**END OF SECTION**

## SECTION 01 73 29 - CUTTING AND PATCHING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. General requirements related to cutting (including excavating), fitting, and patching of the work to:
  - 1. Make several parts fit properly.
  - 2. Uncover work to provide for installation, inspection, or both, of ill-timed work.
  - 3. Remove and replace work nonconforming to Contract Documents.
  - 4. Remove and replace defective work.

#### 1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate with Owner prior to cutting for any items that affect structural safety for permission to proceed with cutting.
- B. Preinstallation Meetings: Review conflicts and/or impacts as required with trades affected by cutting and patching prior to proceeding with work. IF EXISTING CONCRETE IS FOUND TO NOT HAVE A VAPOR BARRIER BELOW THE SLAB, NOTIFY ARCHITECT IMMEDIATELY.

#### 1.3 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. For work removed and replaced, use methods and materials which comply with Specifications and applicable codes. Where new finishes are not noted to match adjoining surfaces affected by the work, match adjoining surfaces with like materials and colors to match existing.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Inspect existing conditions, including items subject to cutting, excavating, backfilling, patching, movement, or damage in preparation for new work. If uncovered condition is not as anticipated, notify Owner and Architect prior to proceeding.
- B. Provide protection including, but not limited to, dust control, shoring, bracing, support for structural integrity, and physical separation to owner equipment or personnel.

#### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Perform excavating and backfilling as required per Construction Documents.
- C. Performing cutting and removal of materials by methods to prevent damage to other portions of work and to prepare surfaces for installation of repair or new work.
- D. Patch as required for filling in and restoration of surfaces and materials to match adjoining construction.

**END OF SECTION**



## SECTION 01 78 00 - CLOSEOUT SUBMITTALS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

#### 1.3 SUBMITTALS

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

### PART 3 EXECUTION

#### 2.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Addenda.
  - 3. Change Orders and other modifications to the Contract.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Record Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 3. Field changes of dimension and detail.

4. Details not on original Contract drawings.

## **2.2 OPERATION AND MAINTENANCE DATA**

- A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

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

- A. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- B. Additional information as specified in individual product specification sections.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

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

- A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- B. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- D. Include manufacturer's printed operation and maintenance instructions.
- E. Include sequence of operation by controls manufacturer.
- F. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

## **2.5 WARRANTIES AND BONDS**

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

**END OF SECTION**



## **SECTION 01 79 00 - DEMONSTRATION AND TRAINING**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

#### **1.2 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
  - 2. Submit one copy to the Commissioning Authority, not to be returned.
  - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
  - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

#### **1.3 QUALITY ASSURANCE**

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

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

### **PART 3 EXECUTION**

**END OF SECTION**





## SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SUMMARY

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

#### 1.2 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Plumbing Systems:
  - 1. Water heaters.
  - 2. Booster pumps.
- C. HVAC System, including:
  - 1. Major and minor equipment items.
  - 2. Terminal units.
  - 3. Control system.
  - 4. Variable frequency drives.
- D. Electrical Systems:
  - 1. Power quality.
  - 2. Emergency power systems.
  - 3. Lighting controls other than manual switches.
- E. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

#### 1.3 RELATED REQUIREMENTS

- A. Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.
- B. Section 01 91 14 - Commissioning Authority Responsibilities.
- C. Section 23 08 00 - Commissioning of HVAC: HVAC control system testing; other requirements.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
  - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.

2. Submit one copy to the Commissioning Authority, not to be returned.
  3. Make commissioning submittals on time schedule specified by Commissioning Authority.
  4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
  5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
- B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
1. Manufacturer's product data, cut sheets, and shop drawings.
  2. Manufacturer's installation instructions.
  3. Startup, operating, and troubleshooting procedures.
  4. Fan and pump curves.
  5. Factory test reports.
  6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.

## **PART 2 PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
  2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
  3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

## **PART 3 EXECUTION**

### **3.1 COMMISSIONING PLAN**

- A. Commissioning Authority has prepared the Commissioning Plan.
1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
  2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.

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

### 3.2 STARTUP PLANS AND REPORTS

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

### 3.3 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
  - 1. No sampling of identical or near-identical items is allowed.
  - 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
  - 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
    - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
    - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
    - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
    - d. Serial number of installed unit.
    - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
    - f. Sensor and actuator calibration information.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
  - 1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
  - 2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
  - 3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.



4. If any Checklist line item is not relevant, record reasons on the form.
  5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
  6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
  7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in Contract Documents.
  2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
  3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
  4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
  2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

### 3.4 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
  2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
  3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
  4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.

5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E. Functional Test Procedures:
1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
  2. Examples of Functional Testing:
    - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
    - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
    - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
    - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

### 3.5 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
  2. Verify that sensors with shielded cable are grounded only at one end.
  3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
  4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
  2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
  3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.

2. Connect a signal generator in place of sensor.
  3. Connect ammeter in series between transmitter and building automation system control panel.
  4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
  5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
  6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
  7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
  8. Reconnect sensor.
  9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
  10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
  11. If not, replace sensor and repeat.
  12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
  2. Pressure, Air, Water, Gas: 3 percent of design.
  3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
  4. Relative Humidity: 4 percent of design.
  5. Barometric Pressure: 0.1 inch of Hg.
  6. Flow Rate, Air: 10 percent of design.
  7. Flow Rate, Water: 4 percent of design.
  8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
  2. Set pump/fan to normal operating mode.
  3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
  4. Command valve/damper to open; verify position is full open and adjust output signal as required.
  5. Command valve/damper to a few intermediate positions.
  6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
  2. Use an ultra-sonic flow meter to detect flow or leakage.

### **3.6 TEST PROCEDURES - GENERAL**

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.

- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
  2. Sampling is not allowed for:
    - a. Major equipment.
    - b. Life-safety-critical equipment.
    - c. Prefunctional Checklist execution.
  3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
  4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
  5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
  6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
  7. If YY percent of the units in the second sample fail, test all remaining identical units.
  8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
  2. Other points will be monitored by the Commissioning Authority using dataloggers.
  3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
  4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
  5. Graphical output is desirable and is required for all output if the system can produce it.
  6. Monitoring may be used to augment manual testing.

### 3.7 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 - Closeout Submittals for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.



- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

**END OF SECTION**



## SECTION 01 91 14 - COMMISSIONING AUTHORITY RESPONSIBILITIES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority's responsibilities for commissioning:
  - 1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
  - 2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
  - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
  - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is specified.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
- C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
- D. The scope of commissioning activities is defined in Section 01 91 13 - General Commissioning Requirements.
- E. Contractor's responsibilities are defined in Section 01 91 13 - General Commissioning Requirements.

#### 1.2 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.
- B. Checklists: project and element-specific checklists that are developed and used during all phases of the Cx to verify that the Owner's Project Requirements (OPR) are being achieved. Checklists are used for general evaluation, testing, training and other design and construction requirements.
- C. Commissioning Authority (CxA): A qualified and certified firm or individual responsible for delivery of the commissioning process.
- D. Commissioning Process (Cx): Quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.
- E. Deferred Tests: Tests performed after Date of Substantial Completion, with Owner's approval, due to seasonal requirements, site conditions, or both, that prohibit the tests from being performed prior to achieving Substantial Completion.
- F. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Contract Documents.
- G. Integrated System Test: Test of multiple systems that are designed to dynamically function and operate in coordinated and properly sequenced fashion. Tests are intended to be conducted under various modes and through every specified sequence of operations.

### 1.3 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process.
- B. ICC (IECC) - International Energy Conservation Code.
- C. NECA 90 - Standard for Commissioning Building Electrical Systems.

### 1.4 SUBMITTALS

- A. Commissioning Plan:
  - 1. Submit preliminary draft for review by Owner and Architect within 30 days after commencement of Commissioning Authority contract.
  - 2. Submit revised draft to be included in the construction Contract Documents, not less than 4 weeks prior to bid date.
  - 3. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.
- B. List of Prefunctional Checklists to be developed:
  - 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  - 2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
  - 3. Submit final list not more than 60 days after start of construction.
- C. Prefunctional Checklists:
  - 1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  - 2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
  - 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- D. List of Functional Test procedures to be developed:
  - 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  - 2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in Contract Documents; this is intended to be a list of titles, not full description of the tests.
  - 3. Submit final list not more than 60 days after start of construction.
- E. Functional Test Procedures:
  - 1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
  - 2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
  - 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- F. Preliminary Commissioning Report: Submit to Authority Having Jurisdiction, as required by ICC (IECC). Include the following information, as applicable to the project:
  - 1. Plumbing - Service Hot Water Systems: Provide information for water heating equipment efficiencies, hot water piping insulation, and controls for hot water recirculation.
  - 2. Mechanical Systems: Provide information for adjusting and balancing, minimum equipment efficiencies, HVAC system controls, duct insulation and sealing, energy recovery system, kitchen exhaust system, demand control ventilation, fan efficiencies, economizers, and walk-in coolers and freezers refrigeration systems.
  - 3. Electrical Systems: Provide information for occupant sensors, time switch controls, daylight responsive controls, and electric motor/transformer efficiencies.
- G. Training Plan.

- H. Recommissioning Manual: Submit within 60 days after receipt of Owner's instructions to proceed with preparation.
- I. Commissioning Process Record: Submit to Contractor for inclusion with O&M manuals. Include, at a minimum the following:
  - 1. Issues Log
  - 2. Construction Checklists
  - 3. CxA Site Visit and Cx Team Meeting Minutes
  - 4. O & M Review
  - 5. Training Documentation
  - 6. Warranty Review
  - 7. Test Data Reports
  - 8. Summary Report
- J. Final Commissioning Report: Submit to Owner. Include the following:
  - 1. A statement that systems have been completed in accordance with Contract Documents, and that the systems are performing in accordance with the final Owner's project requirements document.
  - 2. Identification and discussion of any substitutions, compromises, or variances between the final design intent, Contract Documents and as-built conditions.
  - 3. Summary of issues, both resolved and unresolved, and any recommendations for resolution of remaining items.
  - 4. A list of post-construction activities and results including deferred & seasonal testing results, test data reports and additional training documentation.
- K. Commissioning Firm's Qualification Statement.

## 1.5 QUALITY ASSURANCE

- A. Commissioning Firm Qualifications: Firm experienced in commissioning assemblies and systems specified to be included in scope of work of this Section, and certified by one or more of the following organizations.
  - 1. AABC Commissioning Group (ACG), for commissioning of HVAC Systems and Special Ventilation Systems.
    - a. Commissioning Team Leader: AABC Certified Commissioning Authority (CxA). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
    - b. Commissioning Team Members: Certified Commissioning Technicians (CxT) employed by commissioning firm and working under direct supervision of CxA.
  - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for commissioning of HVAC Systems
    - a. Commissioning Team Leader: ASHRAE Certified Building Commissioning Professional (BCxP). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
    - b. Commissioning Team Members: Certified Commissioning Technician (CxT) Technicians employed by commissioning firm and working under direct supervision of BCxP.
  - 3. Association of Energy Engineers (AEE) for commissioning of HVAC Systems
    - a. AEE Certified Building Commissioning Professional (CBCP)
    - b. Commissioning Team Members: Certified Commissioning Technicians (CxT) employed by commissioning firm and working under direct supervision of BCxP.
  - 4. Building Commissioning Association (BCxA) for commissioning of HVAC Systems
    - a. Commissioning Team Leader: BCA Certified Commissioning Professional (CCP). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
    - b. Commissioning Team Members: Associate Commissioning Professional employed by commissioning firm and working under direct supervision of CCP.

5. National Environmental Balancing Bureau (NEBB) for commissioning of HVAC Systems
  - a. Commissioning Team Leader: NEBB Commissioning Certified Professional (CxCP). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
  - b. Commissioning Team Members: Commissioning Certified Technicians (CxCT) employed by commissioning firm and working under direct supervision of CxCP.
- B. Commissioning Plan: Prepare a plan that provides direction for commissioning tasks during construction phase of the project. Include, at a minimum, the following content at the level of detail appropriate to project scope and complexity:
  1. General project information.
  2. List of team members.
  3. Team members' roles and responsibilities
  4. Description of the goals of the plan.
  5. Abbreviations and definitions used in the document.
  6. Scope of commissioning activities.
  7. List of project commissioned systems and assemblies.
  8. Proposed overall schedule, tied to project construction schedule.
  9. General management plan.
  10. Description of the commissioning process, including documents to be used for facilitating:
    - a. Review of Mechanical, Temperature Control, Lighting Control and pertinent Plumbing system submittals.
    - b. Prefunctional checking and readiness verification.
    - c. Start-up plan and procedures.
    - d. Functional test plan and verification procedures.
    - e. Retesting procedures.
    - f. Management protocols for address deficiencies due to defective products or non-complying work.
    - g. Management protocols for addressing other project-specific issues.
  11. Phased commissioning activities, planned and unplanned.
  12. Warranty period seasonal and deferred testing.
  13. Progress reporting and log for tracking issues.
  14. Training and orientation of Owner's personnel above and beyond.
  15. Commissioning record table of contents.

## **PART 3 EXECUTION**

### **2.1 COMMISSIONING PLAN**

- A. Prepare and implement the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
  1. Call and chair meetings of the Commissioning team when appropriate.
  2. Give Contractor sufficient notice for scheduling commissioning activities.
  3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
  4. ASHRAE Guideline 1.1 may be used as a guide for the Commissioning Plan.
  5. Avoid replication of information included in the construction Contract Documents to the greatest extent possible.
- B. Review the construction Contract Documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.
- C. Commissioning Schedule:
  1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.

2. Contractor's scheduling responsibilities are specified in the construction Contract Documents.
  3. Revise and re-issue schedule monthly.
  4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
  5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.
- D. Commissioning Team: Project manager or other designated person of:
1. Owner's building or plant operation staff.
  2. Commissioning Authority.
  3. Construction Manager.
  4. Design professional's design team.
  5. Plumbing subcontractor.
  6. HVAC subcontractor.
  7. HVAC control system subcontractor.
  8. HVAC testing, adjusting, and balancing (TAB) subcontractor.
  9. Electrical subcontractor.
  10. Other subcontractors who will be required to perform commissioning activities.

## 2.2 CONSTRUCTION CONTRACT DOCUMENTS

- A. General Commissioning Specifications: Architect has prepared general commissioning specifications for inclusion in the construction Contract Documents; review and submit comments to Owner.
1. These specifications include:
    - a. Procedures applicable to all types of items to be commissioned.
    - b. General commissioning procedures for plumbing.
    - c. General commissioning procedures for HVAC.
    - d. General commissioning procedures for building automation system.
    - e. General commissioning procedures for electrical.
  2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction Contract Documents by Architect:
    - a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
    - b. Additional Owner personnel training.
    - c. Additional operation or maintenance data that should be submitted.
- B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
  2. The Checklist forms are intended to be part of the Contractor's Contract Documents.
- C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
  2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.
- D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction Contract Documents.
- E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction Contract Documents

## 2.3 PREFUNCTIONAL CHECKLISTS

- A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
  2. Identify each Checklist by using Contract Documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
  3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
  4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
  5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
  6. Include line items for each physical inspection to be performed.
  7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
  8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
  9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.
- B. Prefunctional Checklists - Format:
1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
  2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
  3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two check boxes:
    - a. "This Checklist is submitted for approval with no exceptions."
    - b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
  4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
  5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

## 2.4 FUNCTIONAL TEST PROCEDURES

- A. Develop test procedures in sufficient detail to demonstrate that functional performance is in accordance with Contract Documents, including proper operation through specified modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part- and full-load regimes.
1. Obtain assistance and review by installing subcontractors.

2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.
  3. Include test setup instructions, description of tools and apparatus, special cautions, and.
  4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
  5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring, or manual functional testing.
  6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.
- B. Functional Test Forms: Prepare and distribute forms in advance of testing. Use a consistent format to the greatest degree practicable. For each form, include the following:
1. General and specific instructions for using form.
  2. Document Identifiers:
    - a. Date and Test Party Identifier: Identification of the date(s) of the test, and the party conducting it.
  3. Checklist of activities required of the Contractor prior to, during, and after the testing.
  4. Complete testing procedure information.
    - a. Instrumentation: A listing of instrumentation and tools necessary to complete the test.
    - b. Test Instructions: Step-by-step instructions of how to complete the test, including functionality to test, and conditions under which the tests should be performed. Include instructions for returning affected systems and equipment to their as-found state at the conclusion of the tests.
    - c. Acceptance Criteria: Measurable pass/fail criteria for each step of the test, as applicable.
      - 1) Referenced Criteria: Identify the source for required performance criteria.
  5. Test Data:
    - a. Results: Include side-by-side space for recording the expected system response and the actual response. Note observed readings, results, and adjustments.
    - b. Deficiencies: Include space for a list of any discovered deficiencies and for an explanation of how they were mitigated.
  6. "Yes/No" check boxes to for documenting status of completion of required testing prerequisites and procedures.
    - a. Functional Test Prerequisites Check boxes: Include for applicable items:
      - 1) Related equipment has been started up, and start-up reports and Prefunctional Checklists have been submitted and approved, and are ready for Functional Testing.
      - 2) Control system functions for this and any interlocking systems have been programmed and are operable in accordance with Contract Documents, including final set points and schedules with debugging, loop tuning, and sensor calibrations completed.
      - 3) Incomplete items identified by Architect during closeout inspections have been corrected or completed.
      - 4) Vibration control report has been approved (if required).
    - b. Functional Test Check boxes: Include for applicable items:
      - 1) Procedures have been reviewed and approved by the affected installer.
      - 2) Safeties and operating ranges have been reviewed.
      - 3) False loading equipment, system and procedures are ready.
      - 4) Sufficient clearance around equipment for servicing has been provided.
      - 5) Original values of pre-test setpoints that need to be changed to accommodate testing have been recorded, .
  7. List of Attachments.
    - a. A copy of the specified sequence of operation.
    - b. A copy of applicable schedules and setpoints.
    - c. A copy of the specified Functional Test Procedures is attached.

- 1) Any other items on the Prefunctional Checklist or Start-up Reports that need to be re-verified.
8. Signature Block: Signature of the designated commissioning lead and the system and equipment installer attesting that the recorded test results are accurate.
- C. Functional Performance Testing Reports: Use completed forms specified above, supplemented with additional information or explanations.
  1. Precautions Taken: Identify and describe actual precautions taken and how they mitigated potential risks inherent in testing procedures.
  2. Instrumentation Used: If necessary, amend the original list to report the actual instrumentation and tools used.
  3. Description of Test Procedures: If necessary, amend in appropriate detail the original sequence of steps to report actual steps taken to complete each functional performance test and the conditions under which the tests were performed.
  4. Deficiencies: List any discovered deficiencies and how they were mitigated.

## 2.5 CONSTRUCTION PHASE

- A. Coordinate the commissioning work with Contractor and Construction Manager; ensure that commissioning activities are being incorporated into the master schedule.
- B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.
- C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review proposed commissioning schedule, activities, and responsibilities with parties involved. Require attendance by every member of the Commissioning Team.
- D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.
- E. Submit periodic progress reports to Owner and Contractor.
- F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly defined in warranties.
- G. Review and approve submittals directly related to commissioning.
- H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.
- I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.
- J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.
- K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.
- L. HVAC Commissioning:
  1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
  2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
  3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
  4. Review TAB Plan prepared by Contractor.



5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
  6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
  7. Analyze trend logs and monitoring data to verify performance.
  8. Prepare a standard trend logging package of primary parameters that will provide Owner's operations staff clear indications of system function in order to identify proper system operation and trouble shoot problems; provide any additional information needed to interpret the trend logs.
- M. Building Automation Systems Commissioning:
1. Comply with requirements of applicable Division 23 sections.
- N. Lighting Control Systems Commissioning:
1. Comply with requirements of applicable Division 26 sections.
- O. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer's personnel; include documentation in O&M manuals.
- P. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.
- Q. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.
- R. Operation and Maintenance Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.
- S. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

## 2.6 TRAINING

- A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.
1. Include a \_\_\_ hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
  2. Include a \_\_\_ hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test forms for re-commissioning purposes.
  3. Establish criteria for determining satisfactory completion of training.
- B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.

## 2.7 CLOSEOUT

- A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
1. Include the Final Commissioning Plan and Final Report.
  2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
    - a. Design intent documentation, furnished by Architect or others.
    - b. Detailed operational sequences.
    - c. Startup plan and approved startup reports.
    - d. Filled out Prefunctional Checklists.
    - e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
    - f. Training plan and training records.
    - g. Recommissioning recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.
- B. Final Commissioning Report: Include:

1. Executive summary.
  2. List of participants and roles.
  3. Brief facility description.
  4. Overview of commissioning scope and general description of testing and verification methods.
  5. For each item commissioned, an evaluation of adequacy of:
    - a. The product itself; i.e. compliance with Contract Documents.
    - b. Installation.
    - c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
    - d. O&M documentation, including design intent.
    - e. Operator training.
  6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
  7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
  8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).
  9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.
- C. Recommissioning Manual: Revise the Commissioning Plan documents, checklists, and Functional Test forms as necessary based on accepted recommendations of the final Commissioning Report. Provide step-by-step instructions for recommissioning, blank forms, and cross-references to O&M data needed during recommissioning.

## **2.8 POST-OCCUPANCY PHASE**

- A. Assist in the development of a preventative maintenance plan, a detailed operating plan or an energy and resource management plan or as-built documentation.
- B. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.
- C. On-Site Review: 10 months after Substantial Completion conduct on-site review with Owner's staff.
  1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
  2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
  3. Make suggestions for improvements and for recording these changes in the O&M manuals.
  4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.
  5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

**END OF SECTION**

## SECTION 02 01 00 - MAINTENANCE OF EXISTING CONDITIONS

### PART I - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Protection of existing buildings, facilities, utilities and site improvements to remain.
2. Verification of existing utilities, site improvements and site conditions.

B. Related Sections:

1. Division 02 Section "Selective Site Demolition".

#### 1.2 SUBMITTALS

A. Shop Drawings: submit drawings showing details of any proposed construction which is necessary to protect existing construction and utilities.

B. Engineering Design:

1. If required by job conditions, Contractor shall retain the services of a licensed Professional Engineer registered in the state in which the project is located to design temporary and permanent installations as required to protect existing improvements and conditions.
2. All information required for the design shall be the Contractor's responsibility to obtain.
3. Submit design drawings and calculations to the Architect/Engineer for review. Review by the Architect/Engineer shall not relieve Contractor of full responsibility for design or work. The purpose of the Architect/Engineer review shall be only to protect the Owner from inadequate or insufficient protection for existing improvements and conditions. By reviewing the design, the Architect/Engineer assumes no responsibility for the design or adequacy thereof.
4. Underpinning calculations, if required, shall be reviewed by the Geotechnical Engineer.
5. All design drawings and calculations submitted shall be signed and sealed by the Contractor's Engineer.

#### 1.3 PROJECT CONDITIONS

A. Existing Site Conditions:

1. The Drawings do not propose to show all existing improvements on the site.
2. Information shown on the Drawings was obtained from drawings of previous construction projects and/or a site survey provided by the Owner.
3. Recorded information concerning existing construction is available for examination in the Architect/Engineer office.
4. Existing structures:
  - a. Bottom of existing footing elevations are unknown.
  - b. Loads on existing footings and foundations are unknown.
  - c. Dimensions of existing foundations are unknown.
5. Information regarding existing subsurface conditions is unconfirmed. See Division 00 Section "Geotechnical Data" for available information regarding Geotechnical Data and soils information.
6. Information concerning the approximate locations of known existing underground utilities is shown on the Drawings. Depths and locations of existing utilities are unconfirmed.
7. Utilities include all underground and above ground piping, conduits, cables and related structures and appurtenances. Utilities also include sewers.

B. Contractor is responsible for field verifying all existing site conditions.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. General:

1. Contractor may use materials and systems recognized as suitable for protection of existing improvements and conditions.
2. Untreated wood may only be used for temporary protection, bracing, supports, shores, etc.
3. The Owner or Architect/Engineer may prohibit certain materials and systems if they interfere with the Owner's operations.

## PART 3 - EXECUTION

### 3.1 PREPARATION

#### A. Pre-Bid Site Inspection:

1. Bidders shall examine the site, inspect existing buildings, review existing plans and become familiar with all conditions under which the contract work will be performed.
2. This shall be completed during the bidding phase in order that bids include all costs for protection of existing improvements and conditions.
3. Contractor shall notify Architect/Engineer during the bidding phase of any discrepancies in bidding documents, existing conditions documents and field conditions.
4. No later claim for extra compensation will be allowed, unless it is determined by the Owner and Architect/Engineer to be unforeseen conditions.

B. Pre-Construction Verification of Existing Conditions:

1. Contractor shall verify all existing site conditions and improvements prior to construction, which includes field verifying locations of existing utilities and all other existing above grade and below grade improvements which may affect proposed construction activities.
2. Contractor shall notify Architect/Engineer immediately with conflicts or discrepancies from existing field conditions, existing conditions documentation and proposed new construction.
3. These verifications are to be done well in advance of construction activities in order to allow time for revising design if required.

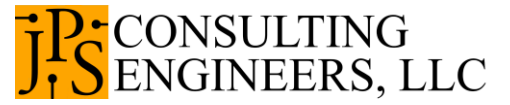
3.2 GENERAL

- A. Contractor shall have underground utilities marked prior to beginning any excavation or other underground work in area of proposed activity.
- B. Provide all permanent and temporary construction necessary to protect existing improvements and conditions as required by construction activities.
- C. Install all protection in a manner which will not interfere with the Owner's operations or adjacent work.
- D. If at any time movement or other failure is observed in existing improvements or conditions, cease operations, provide all additional protection necessary to stabilize and retain said existing installations and notify Owner immediately.

3.3 JOB COMPLETION

- A. Upon completion of construction activities, leave the site in a neat and orderly condition.
- B. Restore all areas disrupted by construction activities, which were to remain and not be altered, to their original condition at no additional cost to Owner.

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END OF SECTION 02 01 00

## SECTION 02 41 00 - DEMOLITION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
- B. Selective demolition of built site elements.
- C. Selective demolition of building elements for alteration purposes.
- D. Abandonment and removal of existing utilities and utility structures.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- B. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- C. Section 31 22 00 - Grading: Rough and fine grading.
- D. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- E. Section 31 23 23 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

#### 1.3 DEFINITIONS

- A. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.
- B. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
- C. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to Owner in ready-for-reuse condition.
- D. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
- E. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

#### 1.4 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Demolition firm qualifications.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.
- D. Qualification Data: Refrigerant Recovery Technician including statement signed by refrigerant recovery technician responsible for covering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

- F. Proposed Protection Measures: Submit report, including Drawings, that indicate measures proposed for protection individuals and property, for environmental protection, for dust control, and for noise control.

## 1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
  - 1. Minimum of 5 years of documented experience.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Fill Material: See Section 31 23 23.

## PART 2 EXECUTION

### 3.1 DEMOLITION

- A. Remove paving and curbs required to accomplish new work.
- B. Within area of new construction, remove foundation walls and footings completely.
- C. Outside area of new construction, remove foundation walls and footings to minimum 2 feet below finished grade.
- D. Remove other items indicated, for salvage, relocation, and recycling.
- E. Locate tensioned steel tendons and include recommendations for de-tensioning.

### 3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Use of explosives is not permitted.
  - 3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 4. Provide, erect, and maintain temporary barriers and security devices.
  - 5. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  - 6. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 7. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
  - 8. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
  - 9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
  - 1. Owner shall remove mobile items prior to demolition starting.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.
- E. Protect existing structures and other elements to remain in place and not removed.
  - 1. Provide bracing and shoring.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.



- F. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. Hazardous Materials:
  - 1. If hazardous materials are discovered during removal operations, stop work and notify Construction Manager and Owner; hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
- H. Perform demolition in a manner that maximizes salvage and recycling of materials.
- I. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.
- J. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify conditions and contents of hidden space before starting flame-cutting operations. Maintain fire suppression devices during flame-cutting operations. Maintain fire watch during and after flame-cutting operations. Maintain adequate ventilation when using cutting torches.

### 3.3 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

### 3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Existing construction and utilities indicated on drawings are based on casual field observation and existing record documents only.
  - 1. Verify construction and utility arrangements are as indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from areas that remain occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction as required to protect existing building to remain. .
- C. Maintain weatherproof exterior building enclosure, except for interruptions required for replacement or modifications; prevent water and humidity damage.
- D. Remove existing work as indicated and required to accomplish new work.
  - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction indicated.
  - 2. Remove items indicated on drawings.
- E. Services including, but not limited to, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove existing systems and equipment as indicated.
  - 1. Maintain existing active systems to remain in operation, and maintain access to equipment and operational components.



2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  3. Verify that abandoned services serve only abandoned facilities before removal.
  4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings. Remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
1. Prevent movement of structure. Provide shoring and bracing as required.
  2. Perform cutting to accomplish removal work neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch to match new work.

### **3.5 DEBRIS AND WASTE REMOVAL**

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.
- D. Repair damage to adjacent buildings or site caused by demolition operations.

**END OF SECTION**

SECTION 02 41 13 - SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition of existing site improvements made obsolete by this project, as indicated or implied by the contract documents.
2. Removal of demolition items and debris from site.
3. Protection of items to remain.
4. Abandonment of items indicated in contract documents.
5. Removal, storage and protection of items to be salvaged.
6. The removal of asbestos or lead containing products is not included in this scope of work. If such materials are discovered during demolition, notify the Owner immediately.

1.2 REQUIREMENTS

A. General:

1. Proper access and function of existing facility operations must be maintained at all times.
2. Demolition activities shall not interfere with or interrupt the operations of the facility, employees or the public.
3. A complete and operable utility system must be maintained at all times.
4. Sufficient parking and site access must be maintained at all times.
5. The route for construction traffic and the removal of debris shall be limited to specific areas. See Drawings for further information.
6. Contractor is solely responsible for providing all permanent and temporary means to ensure site access, utility services and other required conditions are maintained at all times.

B. Miscellaneous:

1. On-site burning is not permitted.
2. Blasting or any other use of explosives is not permitted.
3. Use of heavy vibratory or other similar means that cause excessive nuisance to the public or compromise safety of existing facilities is not permitted.
4. Comply with NFPA 241 (latest edition).

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Concrete: If required, shall comply with Division 32 Section "Site Concrete".
- B. Flowable Fill: If required, shall comply with Division 31 Section "Flowable Fill".
- C. All other materials not specifically described but required for proper completion of the Work, shall be selected by the Contractor subject to approval of the Architect/Engineer and Owner.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Refer to Division 02 Section "Maintenance of Existing Conditions" for verification and maintenance of existing site conditions.
- B. Coordination:
  - 1. Contact Owner prior to site mobilization to discuss and verify site access and routing requirements. Prepare a schedule if requested by Owner.
  - 2. Before commencing the work of this Section, verify with the Architect/Engineer and Owner all items to be removed, all items to remain and all items to be salvaged.

### 3.2 GENERAL

- A. Protection:
  - 1. Demolition shall be done in such a manner to protect adjacent materials.
  - 2. Use all necessary and appropriate means to prevent the spread of dust during demolition.
  - 3. Protect employees and public from dust, noise, light, vibration, odor and all other types of nuisances and hazards.
  - 4. Protect all existing items to remain. If such items are damaged, they shall be repaired or replaced by the Contractor to the Owner's satisfaction at no additional cost to Owner.
  - 5. Items to be demolished as indicated in contract documents or made obsolete per field conditions shall be removed and disposed of off the project site. Abandoning such items in place shall not be permitted unless specifically indicated in the contract documents or approved by Architect/Engineer and Owner.
  - 6. Avoid overloading of existing structures by either a build-up of demolished items or by impact loading of demolished items on the existing structure.

7. Bracing and shoring and other similar and appropriate means shall be used where necessary to avoid collapse or other compromising of structures or materials.

B. Demolition:

1. Items indicated in contract documents to be demolished shall be removed, demounted or disconnected in the best possible manner to ensure that no damage will result to other adjacent items or surfaces to remain.
2. Abandoning demolished items in place is not permitted unless specifically indicated in the contract documents or approved by Architect/Engineer and Owner.
3. For items indicated or approved as being abandoned in place, the means of abandonment shall be reviewed and approved by the Architect/Engineer and Owner prior to abandonment.
4. Phase demolition as described in the contract documents, as required per field conditions and per Owner's request.

C. Salvage:

1. Protect items to be salvaged during removal, handling and storage.
2. All reusable items salvaged during demolition operations shall be retained for the Owner's inspection. Only items so inspected and rejected by the Owner shall be disposed. All other such items shall be turned over to the Owner.

D. Cleaning:

1. Areas in which demolition and salvage work are being done shall be cleaned daily.
2. All dirt, dust, debris, unsalvageable and non-reusable items and similar items shall be removed from the project site daily.
3. Under no circumstances shall such refuse be allowed to collect for longer periods.
4. Refuse shall not be allowed to block or otherwise impair circulation in corridors, stairs, sidewalks or other traffic areas at any time.

E. Disposal:

1. Except for items or materials indicated to be reused, salvaged, reinstalled or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them at an EPA-approved landfill.

### 3.3 JOB COMPLETION

- A. At the completion of demolition activities, ensure all demolition debris is removed from site. Restore adjacent areas to original condition and repair any damaged items to Owner's satisfaction at no additional cost to Owner.

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END OF SECTION 02 41 13

## SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Concrete formwork.
- B. Floors and slabs on grade.
- C. Concrete foundation walls.
- D. Concrete reinforcement.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads, equipment pits, light pole bases, flagpole bases, thrust blocks, and manholes.
- G. Concrete curing.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- B. Section 31 31 16 - Termite Control: Field-applied termiticide and mildewcide for concrete surfaces.
- C. Section 32 13 13 - Concrete Paving: Sidewalks, curbs and gutters.

#### 1.3 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary.
- B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide.
- C. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction.
- D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI PRC-305 - Guide to Hot Weather Concreting.
- F. ACI PRC-306 - Guide to Cold Weather Concreting.
- G. ACI PRC-308 - Guide to External Curing of Concrete.
- H. ACI PRC-347 - Guide to Formwork for Concrete.
- I. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials.
- J. ACI SPEC-301 - Specifications for Concrete Construction.
- K. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
- L. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- M. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- N. ASTM C 1064/1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic Cement Concrete.
- O. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
- P. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- Q. ASTM C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- R. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.

- S. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
- T. ASTM C150/C150M - Standard Specification for Portland Cement.
- U. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
- V. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete.
- W. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.
- X. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- Y. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
- Z. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements.
- AA. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- BB. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars.
- CC. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
- DD. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
- EE. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete.
- FF. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
- GG. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
- HH. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- II. ASTM D994/D994M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- JJ. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- KK. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
- LL. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- MM. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- NN. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars.
- OO. COE CRD-C 48 - Handbook for Concrete and Cement Standard Test Method for Water Permeability of Concrete.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
  - 1. For membrane-forming, moisture emission-reducing, curing and sealing compound, provide manufacturer's installation instructions,.
- C. Mix Design: Submit proposed concrete mix design.
  - 1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.



2. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.
  3. Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.
  4. Certificate of Dosage Rate Conformance for ready Mix supplier
    - a. Indicate proposed mix design complies with admixture manufacturer's written recommendations.
- D. Test Reports: Submit report for each test or series of tests specified.
- E. Steel reinforcement shop drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- F. Construction Joint Layout: indicate proposed construction joints required to construct the structure. Location of construction joints is subject to approval of the Architect.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates-supply to on-site special inspections only
- B. Material certificates for each of the following:
  1. Admixtures
  2. Fiber reinforcement
  3. Curing compounds
  4. Floor and slab Treatments
  5. Bonding agents
  6. Adhesives
  7. Vapor retarders
  8. Repair materials when required on project prior to installation
- C. Field quality control reports

### 1.6 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
- B. Manufacture qualifications: a firm experience in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment
- C. Testing Agency Qualifications: An independent agency acceptable to the authorities having jurisdiction, qualified according to ASTM C1077 ASTM E329 for testing indicated.
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D1.4M
- E. Follow recommendations of ACI PRC-305 when concreting during hot weather. and as follows:
  1. Maintain concrete temperature below 90 deg. F at time of placement. Chilled mixing water or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. using liquid nitrogen to cool concrete is Contractors option
  2. Fog spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots or dry areas.
- F. Follow recommendations of ACI PRC-306 when concreting during cold weather and as follows:
  1. When average high and low temperature is expected to fall below 40 deg. F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI SPEC-301
  2. Do not use frozen material or material containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials
  3. Do not use calcium chloride, salt or other materials containing antifreeze agents or chemical accelerator unless otherwise specified and approved in mixture designs.

- G. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for every day of placement.
- H. For slabs indicated to receive membrane-forming, moisture emission-reducing, curing and sealing compound, do not proceed with application unless manufacturer's representative is present for every day of placement.

### **1.7 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide minimum (2) year warranty against defect for material and installation, unless otherwise indicated.
- C. Slabs with Porosity Inhibiting Admixture (PIA) or Moisture Vapor Reducing Admixture (MVRA): Provide warranty to cover cost of flooring failures due to moisture migration from slabs for life of the concrete.
  - 1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.
  - 2. Provide warranty by admixture manufacturer matching terms of flooring adhesive or primer manufacturer's material defect warranty.
- D. Moisture Emission-Reducing Curing and Sealing Compound, Membrane-Forming: Provide warranty to cover cost of flooring delamination failures for 10 years.
  - 1. Include cost of repair or removal of failed flooring, remediation with a moisture vapor impermeable surface coating, and replacement of flooring with comparable flooring system.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Steel reinforcement: deliver, store, and handle steel reinforcement to prevent bending and damage

## **PART 2 PRODUCTS**

### **2.1 FORMWORK**

- A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.
- B. Form Materials: Contractor's choice of standard products including Plywood or metal with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
  - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
  - 2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.
  - 3. Form Coating: Commercially formulated Release agent that will not adversely affect concrete or interfere with application of coatings. Formulate form-release agent with rust inhibitor for steel form-facing materials
- C. Form Ties: Factory fabricated, removable or snap-off glass fiber reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling for concrete on removal
  - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plan of exposed concrete surface.
  - 2. Furnish ties that when removed leave holes no larger than 1 inch in diameter in concrete surface.
  - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or water proofing

### **2.2 REINFORCEMENT MATERIALS**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).

1. Type: Deformed billet-steel bars.
  2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.
1. WWR Style: As indicated on drawings. Steel bar mats ASTM A184/A184M fabricated from ASTM A615/A615M, grade 60 deformed bar, assemblies with clips
- C. Reinforcement Accessories:
1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
  2. Bar supports: Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
  3. Mechanical Splices: Coupler Systems: Mechanical devices for splicing reinforcing bars where indicated on drawings or as voluntary alternate, pretested to develop at least 125% of the reinforcing bar yield strength with specific product approval required from the Architect
  4. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs

## 2.3 CONCRETE MATERIALS

- A. Acquire each type of cementitious material for entire project from same source.
1. Cement: ASTM C150/C150M, Type I - Normal Portland type.
  2. ASTM C595/C595M Blended Hydraulic Cement, Type II, Portland Limestone cement.
  3. Slag Cement ASTM C989/C989M, Grade 100 or 120
  4. Fine and Coarse Aggregates: ASTM C33/C33M.
    - a. Acquire aggregates for entire project from same source.
    - b. Maximum course aggregate size:
      - 1) Footings and Foundations: 1 1/2 inches
      - 2) Slabs on grade 5" thick or less 1 inch
  5. Fly Ash: ASTM C618, Class C or F.
  6. Silica Fume: ASTM C1240, proportioned in accordance with ACI PRC-211.1.
  7. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete. Follow ASTM C94/C94M
  8. Structural Fiber Reinforcement: fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M. Type III
  9. Blended Fiber Reinforcement: ASTM C1116/C1116M, engineered blend of two or more sizes of reinforcing fibers. Fibers required in all slab on grade locations. Refer to drawings for additional information
    - a. Fiber Type: Alkali-resistant synthetic.
    - b. Fiber Length: 0.5 inch to 1.5" multi-design gradation, nominal.
    - c. Products:
      - 1) Fibermesh; Novomesh 950: [www.fibermesh.com/#sle](http://www.fibermesh.com/#sle).
      - 2) Master Builders Solutions; MasterFiber MAC 360 FF: [www.master-builders-solutions.com/en-us/#sle](http://www.master-builders-solutions.com/en-us/#sle).
      - 3) FORTA Corporation
      - 4) Nycon, INCc.
      - 5) Propex Operatiuon Company, LLC
      - 6) BASF Corporation
      - 7) Sika Corporation

## 2.4 ADMIXTURES

- A. Chemical Admixture: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chlorides.
- B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
  - 1. Air Entrainment Admixture: ASTM C260/C260M.
  - 2. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
  - 3. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- C. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
  - 1. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- D. Accelerating Admixture: ASTM C494/C494M Type C.
- E. Moisture Vapor Emission Control
  - 1. Provide Vapor emission control in all interior Slabs on grade unless otherwise noted. Raised slabs on deck if floor finishes to be applied sooner than 120 days after concrete poured
  - 2. Moisture Vapor Reducing Admixture (MVRA): Liquid, inorganic admixture free of volatile organic compounds (VOCs). Closes capillary systems formed during concrete curing to reduce moisture vapor emission and transmission. Reduces concrete shrinkage with no adverse effect on concrete properties or applied flooring.
    - a. Products:
      - 1) AVECS, LLC; PRO-ACT: [www.avecs.build/#sle](http://www.avecs.build/#sle).
      - 2) Barrier One Concrete Admixtures; MVRA-CPS: [www.barrierone.com/#sle](http://www.barrierone.com/#sle).
      - 3) ISE Logik Industries, Inc; MVRA 900: [www.iselogik.com/#sle](http://www.iselogik.com/#sle).
      - 4) Specialty Products Group; Vapor Lock 20/20: [www.spggogreen.com/#sle](http://www.spggogreen.com/#sle).
  - 3. Post applied
    - a. SCP 327 by Spray-lock Concrete protection [www.spraylockcp.com](http://www.spraylockcp.com)
    - b. Creteseal CS2000 by Creteseal [www.creteseal.com](http://www.creteseal.com)
    - c. Synthetics 10-S or 10-TR by Synthetics intl. [www.Syntheticsintl.com](http://www.Syntheticsintl.com)
- F. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
  - 1. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.
  - 2. Permeability of Cured Concrete: No measurable leakage when tested in accordance with COE CRD-C 48 at 200 psi; provide test reports.

## 2.5 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
  - 1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
  - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
  - 3. Products: min thickness of 15 Mils
    - a. Henry Company; Moistop Ultra 15: [www.henry.com/#sle](http://www.henry.com/#sle).
    - b. Stego Industries, LLC: [www.stegoindustries.com/#sle](http://www.stegoindustries.com/#sle).
    - c. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): [www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).
    - d. Fortifiber Building Systems Group
- B. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, nonmetallic aggregate, and activator.

## 2.6 BONDING AND JOINTING PRODUCTS

- A. Bond Break ( for use at interior non-radiant heated floor slabs): turn Vapor Retarder up against wall.
- B. Bond Break(for use at interior non-radiant heated floor slabs where vapor retarder is not available): Asphalt -saturated roofing felt,ASTM D226/D226M , 15lbs, modified bitumen membrane 4 inches wide or as required to match slab thickness or approved equal.
- C. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
  - 1. Slab Isolation and expansion Joint filler strips for use at columns and as indicated on drawings: 1/2-inch thick, height equal to slab thickness, with removable top section forming 1/2-inch deep sealant pocket after removal.
    - a. Material: Closed-cell, non-absorbent, compressible polymer foam in sheet form.
    - b. Products:
      - 1) W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip:  
[www.wrmeadows.com/#sle](http://www.wrmeadows.com/#sle).

## 2.7 CURING MATERIALS

- A. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
  - 1. Comply with ASTM C309 standards for water retention.
  - 2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested in accordance with ASTM C39/C39M.
  - 3. VOC Content: Zero.
- B. Moisture-Retaining Sheet: ASTM C171.
- C. Water: Potable, not detrimental to concrete.

## 2.8 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
  - 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.
- D. Fiber Reinforcement: Add to mix at rate of 1.5 pounds per cubic yard, or as recommended by manufacturer for specific project conditions.
- E. Fly Ash Content: Maximum 20 percent of cementitious materials by weight.
- F. Calcined Pozzolan Content: Maximum 25 percent of cementitious materials by weight combined fly ash and Pozzolan.
- G. Silica Fume Content: Maximum 10 percent of cementitious materials by weight.
- H. Slag Cement Content: 50 percent of cementitious materials by weight
- I. Combined Fly ash or Pozzolan and Slag cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent
- J. Combined Fly Ash, Pozzolans and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent
- K. Combined fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- L. Hydraulic Cement and Portland cement are interchangeable in mix design at Contractors option.

## 2.9 NORMAL WEIGHT CONCRETE:

- A. Concrete mixtures for Footings and Foundations
  - 1. Minimum Compressive strength when tested in accordance with ASTM C39/C39M at 28 days: 4000 PSI
  - 2. Maximum water/cement ratio 50 percent
  - 3. Slump Limit: 4 inches plus or minus 1 inch (6" plus or minus 1" if water reducing admixtures are used)
  - 4. Air Content: 6 percent plus or minus 1.5 percent at point of delivery
  - 5. Aggregate: limestone
- B. Concrete mixtures for Exterior: see 32 13 13 - Concrete Paving.
- C. Concrete mixture for Interior slabs on grade
  - 1. Minimum Compressive strength when tested in accordance with ASTM C39/C39M at 28 days: 4000 psi
  - 2. Maximum water/cement ration 45 percent
  - 3. Slump Limit: 4 inches plus or minus 1 inch (6" plus or minus 1" if water reducing admixtures are used)
  - 4. Synthetic micro fibers per above
  - 5. Moisture mitigation

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

### 3.2 PREPARATION

- A. Formwork: Comply with requirements of ACI SPEC-301. Design, erect and fabricate forms and shoring to support all applied loads until concrete is cured and for easy removal without damage to concrete.
- B. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
  - 1. Use latex bonding agent only for non-load-bearing applications.
- C. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

### 3.3 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded item required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instruction, and directions furnished with items to be embedded.
- B. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- C. Install anchor rods, accurately located to elevations required and complying with tolerances in ACI SPEC-301

### 3.4 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304. and ACI PRC-347
- B. Place concrete for floor slabs in accordance with ACI PRC-302.1.
- C. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- D. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

### 3.5 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
  - 1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.

### 3.6 SEPARATE FLOOR TOPPINGS

- A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
- B. Place required dividers, edge strips, reinforcing, and other items to be cast in.
- C. Place concrete floor toppings to required lines and levels.
  - 1. Place topping in checkerboard panels not to exceed 20 feet in either direction.
- D. Screed toppings level, maintaining surface flatness of maximum 1:1000.

### 3.7 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. Limit concrete surface irregularities designated by ACI PRC-347 as abrupt or gradual as follows:
  - 1. Class A, 1/8" for smooth-formed finished surfaces (concrete surfaces exposed to view):
  - 2. Class C, 1/2" for rough formed finished surfaces (concrete surfaces not exposed to view)
    - a. Under Seamless Resilient Flooring: 1/4 inch in 10 feet.
    - b. Under Carpeting: 1/4 inch in 10 feet.
- B. Correct the slab surface if tolerances are less than specified.
- C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

### 3.8 CONCRETE FINISHING & REPAIR

- A. Repair formed surface defects, including tie holes, immediately after removing formwork. Remove and replace concrete that cannot be repaired and patched to Architects approval
- B. Patching Mortar: Mix dry pack patching mortar, consisting of 1-part portland cement to 2- 1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling, and placing.
- C. Repairing Formed surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projection on the surface, and stains and other discolorations, that cannot be removed by cleaning.
  - 1. immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2" in any dimension to slid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water and brush coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form tie voids with patching mortar or cone plugs secured in place with bonding agent.
  - 2. Repair defects on surfaced exposed to view by blending white portland cement and standard portland cement so that when dry, patching mortar matched surrounding color. Patch test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slight higher than surrounding surface
  - 3. Repair defect as concealed formed surfaces that affect concretes durability and structural performance as determined by Architect.

- D. Repairing unformed surfaces: Test unformed surfaces, such as floor and slabs for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness
1. Repair finished surface containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing, and crack more than .01-inch-wide or that penetrate to reinforcement completely through unreinforced sections regardless of the width, and other objectionable conditions
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low area during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low area schedule to receive floor coverings with a repair underlayment. Prepare, mix and supply underlayment and primer according to manufacturers written instructions to produce a smooth, uniform, plane and level surface. Feather edges to match adjacent floor elevations.
  5. Subject to architect's approval, correct other low area scheduled to remain exposed with a repair topping. Cut out low area to ensure a minimum repair topping depth of 1/4" to match adjacent floor elevations. Prepare, mix and apply repair topping and primer according to manufacturers written instruction to produce a smooth, uniform, plane and level surface.
  6. Subject to Architects approval, repair defective areas, except random crack and single holes 1" or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of the same materials and mixture as the original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
  7. Subject to Architects approval, repair random cracks and single holes 1" or less in diameter, by patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust dirt and loose particles. Dampen concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching Mortar and finish to match adjacent concrete. Keep patched area continually moist for at least 72 hours.
    - a. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
      - 1) Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI PRC-302.1; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
      - 2) Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
      - 3) Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.
    - b. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1:100 nominal.

### 3.9 CURING AND PROTECTION

- A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Formed Surfaces: Cure formed surfaced, including underside of beams, supported slabs, and other similar surfaced by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:



1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap. per ACI PRC-308
2. Final Curing: Begin after initial curing but before surface is dry.
  - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.

### 3.10 LIQUID FLOOR TREATMENT APPLICATION

- A. Penetrating liquid Floor treatment: prepare, apply and finish penetrating liquid floor treatment according to manufacturers written instructions. Clear chemically reactive, waterborne solution of inorganic silicate or silicate material and proprietary components, odorless, that penetrates, hardens, and densifies concrete surfaces.
  1. Remove curing compound, sealers, oil, dirt, laitance and other contaminants and complete surface repairs.
  2. Apply two coats to concrete as directed by the manufacturer.
  3. Allowable manufacturers
    - a. BASF Corporations, Construction Systems
    - b. Dayton Superior
    - c. Euclid Chemical Company
    - d. L&M Construction Chemicals

### 3.11 FIELD QUALITY CONTROL

- A. Provide free access to concrete operations at project site and cooperate with appointed firm.
- B. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements. according to ASTM C172/C172M
- C. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed. test one laboratory cured specimen at 7 days and two at 28 days and test field cured specimens at 28 days
  1. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
  2. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength test equals or exceeds specified compressive strength and no compressive-strength test value falls below the specified compressive strength by more than 500 psi
  3. Test results shall be reported in writing to Architect, concrete manufacturer, and contractor within 48 hours of testing. Reports of compressive- strength test shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspection agency, location of concrete batch in work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests
  4. Nondestructive testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  5. Additional Tests: Testing and inspection agency shall make additional tests of concrete when test results indicate requirements have not been met.As directed by the Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M
  6. Additional testing and inspecting , at contractors expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Perform air content testing per ASTM C143/C143M pressure methods for normal-weight concrete;one test for each set of cylinders

- E. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
- F. Perform concrete temperature test per ASTM C 1064/1064M one test hourly when air temperature is 40 degF and below or 80 deg. F and above and one test for each set of cylinders
- G. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

### **3.12 DEFECTIVE CONCRETE**

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

### **3.13 MISCELLANEOUS CONCRETE ITEM INSTALLATION**

- A. Filing In: Fill in holes and opening left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place and cure concrete , as specified to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the work,
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersection and terminations slightly rounded.
- C. Equipment Bases and Foundation
  1. Coordinate sizes and location of concrete bases with actual equipment provided
  2. Construct concrete bases 4" high unless otherwise indicated and extend base not less than 6" in each direction beyond maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support
  3. Minimum compressive strength: 4000 psi at 28 days.
  4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods at 18" oc and around the full perimeter of concrete base
  5. For supported equipment install epoxy coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  6. Prior to pouring concrete place and secure anchorage devices use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded
  7. Cast anchor bolt insert into bases, install anchor bolts to elevations required for proper attachment to supported equipment.

### **3.14 PROTECTION**

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.
- B. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and material including temporary covering, recommended in writing by liquid floor treatments installer

**END OF SECTION**

## SECTION 04 20 00 - UNIT MASONRY

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Concrete block.
- B. Concrete facing brick.
- C. Clay facing brick.
- D. Mortar and grout.
- E. Reinforcement and anchorage.
- F. Flashings.
- G. Lintels.
- H. Accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 04 01 00 - Maintenance of Masonry.
- B. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
- C. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- E. Section 07 84 00 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- F. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- F. ASTM C55 - Standard Specification for Concrete Building Brick.
- G. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
- H. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
- I. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
- J. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
- K. ASTM C150/C150M - Standard Specification for Portland Cement.
- L. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
- M. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
- N. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- O. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
- P. ASTM C476 - Standard Specification for Grout for Masonry.

- Q. ASTM C780 - Standard Test Methods for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- R. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
- S. ASTM C1634 - Standard Specification for Concrete Facing Brick and Other Concrete Masonry Facing Units.
- T. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing.
- U. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls.
- V. BIA Technical Notes No. 46 - Maintenance of Brick Masonry.
- W. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

#### **1.5 QUALITY ASSURANCE**

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

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

### **PART 2 PRODUCTS**

#### **2.1 CONCRETE MASONRY UNITS**

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
  - 2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
    - a. Provide bullnose units for outside corners.
  - 3. Load-Bearing Units: ASTM C90, normal weight.
    - a. Provide units with minimum average net-area compressive strength of 2500 psi
      - 1) Hollow block, as indicated.
      - 2) Exposed Faces: Manufacturer's standard color and texture where indicated.
  - 4. Nonloadbearing Units: ASTM C129.
    - a. Provide units with minimum average net-area compressive strength of 2500 psi
      - 1) Hollow block, as indicated.
      - 2) Normal weight.
- B. Concrete Brick:
  - 1. Size: As indicated on drawings.
    - a. Provide units with minimum average net-area compressive strength of 2500 psi.
  - 2. Concrete Facing Brick: ASTM C1634; solid, lightweight; for architectural, paver, and below grade use.
    - a. Exposed Faces: Color and texture to match Architect's sample.

#### **2.2 BRICK UNITS**

- A. Manufacturers:
  - 1. Belden Brick; Commodore Full Range Velour: [www.beldenbrick.com/#sle](http://www.beldenbrick.com/#sle).
- B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.

1. Color and texture to match Architect's sample.
2. Nominal size: 3 5/8" W x 7 5/8" L.
3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

### 2.3 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
  1. Not more than 0.10 percent alkali when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.
- E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  1. Color(s): As indicated on drawings.
- F. Water: Clean and potable.

### 2.4 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers:
  1. Hohmann & Barnard, Inc; X-Seal Anchor: [www.h-b.com/#sle](http://www.h-b.com/#sle).
  2. Masonry Reinforcing Corporation of America: [www.wirebond.com](http://www.wirebond.com)
  3. Heckmann Building Products, Inc.: <http://www.heckmannbuildingprods.com/>
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; galvanized.
- C. Single Wythe Joint Reinforcement: ASTM A951/A951M.
  1. Type: Truss or ladder.
  2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
  3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.
- D. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
  1. Type: Ladder, with adjustable ties or tabs spaced at 16 in on center.
  2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
  3. Size: 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1483 inch wire, width of components as required to provide not less than 5/8 inch of mortar coverage from each masonry face.
  4. Vertical adjustment: Not more than 2 inches.
  5. Insulation Clips: Provide clips at tabs or ties designed to secure insulation against outer face of inner wythe of masonry.
- E. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.
- F. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
  2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
  3. Vertical adjustment: Not less than 3-1/2 inches.

## **2.5 FLASHINGS**

## **2.6 LINTELS**

- A. Precast Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 03 30 00 "Cast-in-Place Concrete" and with reinforcing bars indicated.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout (entire height of lintel to be filled in one pour). Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- C. Brickwork Support System: Offset steel relief angles or lintels with hanger brackets for support of brickwork above horizontal masonry joints and openings to allow insulation to span continuously behind brick and eliminate continuous thermal bridges associated with support systems that interrupt continuous insulation.

## **2.7 MORTAR AND GROUT MIXING**

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  - 1. Exterior, loadbearing masonry: Type S.
  - 2. Exterior, non-loadbearing masonry: Type S.
  - 3. Interior, loadbearing masonry: Type S.
  - 4. Interior, non-loadbearing masonry: Type S.
  - 5. Masonry veneer: Type N
  - 6. For other applications where a type is not listed use Type S
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
- D. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

### **3.2 PREPARATION**

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

### **3.3 COLD AND HOT WEATHER REQUIREMENTS**

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### **3.4 COURSING**

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

- D. Brick Units:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches.
  - 3. Mortar Joints: Concave.

### 3.5 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### 3.6 WEEPS/CAVITY VENTS

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

### 3.7 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### 3.8 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 12 inches each side of opening.
- C. Embed longitudinal wires of joint reinforcement in mortar joint with at least 5/8 inch mortar cover on each side.
- D. Lap joint reinforcement ends minimum 6 inches.

- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 36 inches horizontally and 24 inches vertically.
- F. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

### **3.9 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER**

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 18 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

### **3.10 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY**

- A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on drawings.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

### **3.11 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 6 inches, minimum, to form watertight pan at nonmasonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Terminate flashing up 8 inches minimum on vertical surface of backing:
  - 1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
- C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.
- D. Extend metal flashings to within 1/4 inch of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
- E. Lap end joints of flashings at least 4 inches, minimum, and seal watertight with flashing sealant/adhesive.

### **3.12 LINTELS**

- A. Install loose steel lintels over openings where indicated.
- B. Install reinforced unit masonry lintels over openings where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Maintain minimum 8 inch bearing on each side of opening unless otherwise noted.
- D. Install thermal brick support system in accordance with manufacturer's instructions at locations indicated on drawings

### **3.13 GROUTED COMPONENTS**

- A. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web.
- B. Lap splices minimum 24 bar diameters.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.



- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 24 inches either side of opening.

### 3.14 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
- D. Form expansion joints in brick as follows:
  - 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
  - 2. Build flanges of factory-fabricated, expansion joints in masonry
  - 3. Build in compressible joint fillers where indicated.
  - 4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 92 00 "Joint Sealants"
- E. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants", but not less than 3/8 inch.
  - 1. Locate horizontal, pressure-releasing joints beneath shelf angles supporting masonry.

### 3.15 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, glazed frames, anchor bolts, and plates and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.

### 3.16 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Alignment of Columns: 1/4 inch.
- C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/4 inch in 10 ft; 3/8 inch in 20 ft.
- G. Maximum Variation of Mortar Joint Thickness: Bed joint, minus 1/8 inch, plus 1/8 inch with maximum thickness of 1/2 inch.

### 3.17 CUTTING AND FITTING

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

### 3.18 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

- C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

**3.19 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Replace defective mortar. Match adjacent work.
- C. Clean soiled surfaces with cleaning solution.

**3.20 PROTECTION**

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

**END OF SECTION**

## SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Structural steel framing members.
- B. Structural steel support members and struts.
- C. Base plates, shear stud connectors and expansion joint plates.
- D. Grouting under base plates.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 21 00 - Steel Joist Framing.
- B. Section 05 31 00 - Steel Decking: Support framing for small openings in deck.
- C. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

#### 1.3 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
- C. AISC 325 - Steel Construction Manual.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- I. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel.
- J. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- K. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- L. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
- M. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
- N. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- O. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
- P. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.
- Q. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry.
- R. ASTM E709 - Standard Guide for Magnetic Particle Testing.
- S. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
- T. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

- U. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- V. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- W. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification.
- X. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- Y. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172.
- Z. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.
- AA. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- BB. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).
- CC. SSPC-SP 2 - Hand Tool Cleaning.
- DD. SSPC-SP 3 - Power Tool Cleaning.
- EE. UL (FRD) - Fire Resistance Directory.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
  - 2. Connections.
  - 3. Indicate cambers and loads.
  - 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- D. Delegated Design Submittals
  - 1. For structural Steel Moment Connections indicated on drawings to comply with design loads, include analysis data signed and sealed by the qualified MI professional engineer responsible for their preparation.

#### 1.5 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
- C. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.

- D. Steel Shapes, Plates, and Bars: ASTM A242/A242M high-strength, corrosion-resistant structural steel.
- E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- F. Pipe: ASTM A53/A53M, Grade B, Finish black.
- G. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
- H. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.
- I. Specialty Anchors
  - 1. Hilti shall be the basis of design for each specific application. Adhesive anchors to masonry and concrete shall have ICC-ESR Report approval.
  - 2. Steel to hollow-core masonry, solid grouted masonry, and brick masonry: Consisting of a threaded anchor rod, nut, and washer; a cylindrical mesh screen tube, and an injectable adhesive material - HIT HY270 by Hilti. Anchor spacing and embed depths as noted on drawings.
  - 3. Steel to concrete: Consisting of a threaded anchor rod, rebar, or threaded insert and an injectable adhesive material - "Safe Set" HIT HY200 by Hilti. Anchor spacing and embed depths as noted on drawings.
- J. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563/A563M nuts and ASTM F436/F436M Type 1 washers.
- K. Headed Anchor Rods: ASTM F1554 Grade 36, plain.
- L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- M. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
  - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
  - 2. Minimum Compressive Strength at 28 Days: 8,000 pounds per square inch..
- N. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- O. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

## 2.2 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Develop required camber for members.

## 2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, high strength bolted, or galvanized.
- C. Galvanize structural steel members to comply with minimum requirements per ASTM A123/A123M.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

### 3.2 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Verify that all structural steel may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.
- D. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the Architect.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- E. Field weld components and shear studs indicated on shop drawings.
- F. Do not field cut or alter structural members without approval of Architect.
- G. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- H. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.
- I. Holes for post-installed adhesive anchors shall be hammer drilled unless approved by Engineer of Record. Reference ICC-ESR for installation and special inspection requirements.

### 3.3 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.

### 3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts," testing at least 10 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:
  - 1. Radiographic testing performed in accordance with ASTM E94/E94M.
  - 2. Ultrasonic testing performed in accordance with ASTM E164.
  - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
  - 4. Magnetic particle inspection performed in accordance with ASTM E709.

**END OF SECTION**

## SECTION 05 21 00 - STEEL JOIST FRAMING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Open web steel joists and shear stud connectors, with bridging, attached seats and anchors.
- B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
- C. Supplementary framing for roof openings greater than 18 inches.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.
- B. Section 05 12 00 - Structural Steel Framing: Superstructure framing.
- C. Section 05 31 00 - Steel Decking: Bearing plates and angles.
- D. Section 05 50 00 - Metal Fabrications: Non-framing steel fabrications attached to joists.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
- D. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric).
- E. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
- F. ASTM E165/E165M - Standard Practice for Liquid Penetrant Testing for General Industry.
- G. ASTM E709 - Standard Guide for Magnetic Particle Testing.
- H. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
- I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- K. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.
- L. SJI 100 - Standard Specifications for K-Series, LH-Series, and DLH-Series Open Web Steel Joists, and for Joist Girders.
- M. SJI Technical Digest No. 9 - Handling and Erection of Steel Joists and Joist Girders.
- N. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- O. SSPC-SP 2 - Hand Tool Cleaning.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
- C. Fabricator's Qualification Statement.
- D. Erector's Qualification Statement.

## 1.5 QUALITY ASSURANCE

- A. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Perform Work, including that for headers and other supplementary framing, in accordance with SJI 100 Standard Specifications Load Tables and SJI Technical Digest No. 9.
- C. Erector Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products to SJI requirements.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Steel Joists:
  - 1. New Millennium Building Systems: [www.newmill.com/#sle](http://www.newmill.com/#sle).
  - 2. Nucor-Vulcraft Group: [www.vulcraft.com/#sle](http://www.vulcraft.com/#sle).

### 2.2 MATERIALS

- A. Open Web Joists: SJI Type K Joists:
  - 1. Minimum End Bearing on Steel Supports: Comply with referenced SJI standard. Min 2-1/2 inches.
  - 2. Minimum End Bearing on Concrete or Masonry Supports: Comply with referenced SJI standard. Min 4 inches.
  - 3. Finish: Shop primed, unless otherwise noted.
- B. Anchor Bolts, Nuts and Washers: ASTM A307 hot-dip galvanized per ASTM A153/A153M Class C.
- C. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.
- D. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.
- E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.
- F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

### 2.3 FINISH

- A. Shop prime joists as specified.
  - 1. Do not prime surfaces that will be fireproofed.
- B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that all materials may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.
- C. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the Construction Manager.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.



### 3.2 ERECTION

- A. Erect joists with correct bearing on supports.
- B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
- C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
- D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
- E. Install supplementary framing for roof openings greater than 18 inches.
- F. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- G. Do not field cut or alter structural members without approval of joist manufacturer.
- H. After erection, prime welds, damaged shop primer, damaged galvanizing, and surfaces not shop primed, except surfaces specified not to be primed.

### 3.3 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Alignment: 1/4 inch.

### 3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 10 percent or 2 bolts at each connection.
  - 1. Verify high strength bolts used are A325 or A490
  - 2. Require that contact surfaces be tight for bearing connection.
  - 3. Require that slip critical connections be tightened by the Turn-of-the-Nut method and witness erectors tensioning method.
  - 4. Torch Cutting of holes to correct misalignment is not allowed
  - 5. Visually check bolts for proper length, size, and grade.
- C. Perform a cursory inspection of open web steel joists and joist girders for damage, proper anchorage and bridging installation.
- D. Welded Connections: Per AWS D1.1
  - 1. Visually inspect all field-welded connections.
  - 2. Periodically inspect single-pass fillet welds 5/16 inches or less.
  - 3. Continuously inspect single-pass fillet welds greater than 5/16 inches.
  - 4. Continuously inspect multi-pass fillet welds.
  - 5. Continuously inspect complete and partial penetration groove welds.
- E. Welded Connections: Visually inspect all field-welded connections and test at least 10 percent of welds using one of the following:
  - 1. Radiographic testing performed in accordance with ASTM E94/E94M.
  - 2. Ultrasonic testing performed in accordance with ASTM E164.
  - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
  - 4. Magnetic particle inspection performed in accordance with ASTM E709.
- F. Comply with Code - Building or Municipal building inspection code requirements and special inspections if applicable.

**END OF SECTION**



## SECTION 05 31 00 - STEEL DECKING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Acoustical roof deck.
- B. Roof deck.
- C. Metal form deck.
- D. Supplementary framing for openings up to and including 18 inches.
- E. Acoustical insulation in roof deck flutes.
- F. Roof sump pans.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Support framing for openings larger than 18 inches and shear stud connectors.
- B. Section 05 12 00 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
- C. Section 05 21 00 - Steel Joist Framing: Support framing for openings larger than 18 inches and shear stud connectors.
- D. Section 05 21 00 - Steel Joist Framing: Placement of embedded steel anchors for bearing plates and joist seats in cast-in-place concrete.
- E. Section 05 50 00 - Metal Fabrications: Steel angle concrete stops at deck edges.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
- D. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- E. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
- F. ICC-ES AC70 - Acceptance Criteria for Power-Actuated Fasteners Driven into Concrete, Steel and Masonry Elements.
- G. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks.
- H. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- I. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).
- J. UL (FRD) - Fire Resistance Directory.

#### 1.4 COORDINATION

- A. Coordinate all work with job site superintendent and all applicable trades.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

- D. Certificates: Certify that products furnished meet or exceed specified requirements.
- E. Submit manufacturer's installation instructions.

## 1.6 QUALITY ASSURANCE

- A. Steel Deck Institute; SDI NR, "Code of Recommended Standard Practice, Roof Deck Construction"
- B. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.
- C. Protect deck from elements with waterproof covering, ventilating to avoid condensation.

## 1.8 WARRANTY

- A. Provide minimum two (2) year warranty against defects for materials and installation, unless otherwise indicated.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Steel Deck:
  - 1. Canam Steel Corporation: [www.canam-steeljoists.ws](http://www.canam-steeljoists.ws).
  - 2. New Millennium Building Systems: [www.newmill.com/#sle](http://www.newmill.com/#sle).
  - 3. Nucor-Vulcraft Group: [www.vulcraft.com/#sle](http://www.vulcraft.com/#sle).
  - 4. Epic Metals Corp: [www.epicmetals.com](http://www.epicmetals.com)
  - 5. Whelling Corrugating Co: <https://kynar500.arkema.com/en/>
  - 6. Metal Dek Group a Unit of CSI
  - 7. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.2 STEEL DECK

- A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual. Form deck units in lengths to span three or more supports, with flush, telescoped, or nested 2" laps at ends and interlocking or nested side laps, unless otherwise noted.
- B. Acoustical Roof Deck: Non-composite type, steel sheet with plain vertical flute faces perforated with 1/8 inch diameter holes staggered 3/8 inch on center:
  - 1. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 50, Type 1.
  - 2. Primer: Shop coat of manufacturer's standard primer paint over cleaned substrate.
  - 3. Minimum Base Metal Thickness: 16 gauge, 0.0598 inch.
  - 4. Nominal Height: 1-1/2 inch.
  - 5. Profile: Fluted; SDI WR.
  - 6. Formed Sheet Width: 36 inch.
  - 7. Side Joints: Lapped, mechanically fastened.
  - 8. End Joints: Lapped, mechanically fastened.
- C. Roof Deck: 1 1/2" Non-composite type, fluted steel sheet:
  - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 50/230, with G90/Z275 galvanized coating. Refer to plans for requirements.
  - 2. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 50, Type 1.
  - 3. Primer: Shop coat of manufacturer's standard primer paint over cleaned substrate.

4. Minimum Base Metal Thickness, excluding finish: 20 gauge, 0.0359 inch or as shown on drawings.
  5. Nominal Height: 1-1/2 inch.
  6. Profile: Fluted; SDI WR.
  7. Formed Sheet Width: 36 inch.
  8. Side Joints: Lapped, mechanically fastened.
  9. End Joints: Lapped, mechanically fastened.
- D. Metal Form Deck: Corrugated sheet steel, with provision for ventilation of concrete:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 50/230, with G90/Z275 galvanized coating.
  2. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS, Grade 50, Type 1.
  3. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
  4. Minimum Base Metal Thickness: 20 gauge, 1.5 inch.
  5. Nominal Height: 1.5 inch.
  6. Formed Sheet Width: 24 inch.

### 2.3 ACCESSORY MATERIALS

- A. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
- B. Welding Materials: AWS D1.1/D1.1M.
- C. Fasteners: Galvanized hardened steel, self tapping.
- D. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
1. Products:
    - a. HILTI: [www.hilti.com](http://www.hilti.com)
      - 1) Deck to steel joists and structural steel (3/16" and 3/8" thick): Hilti X-EDN19, spacing/pattern as noted on drawings.
      - 2) Deck to structural steel and heavy bar joists (1/4" and thicker): Hilti X-ENP-19L15, spacing/pattern as noted on drawings.
      - 3) Deck to structural steel and bar joists (1/8" to 3/8"): Hilti X-HSN24, spacing/pattern as noted on drawings.
- E. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type II - Organic, complying with VOC limitations of authorities having jurisdiction.
- H. Flute Closures: Closed cell foam rubber, 2 inch thick; profiled to fit tight to the deck.
- I. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft density; profiled to suit deck.

### 2.4 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 20 gauge, 0.0359 inch thick sheet steel; of profile and size as indicated; finished same as deck. Form to provide tight-fitting closures at open end of cells or flutes and sides of decking.
- B. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
- C. Floor Drain Pans: Formed sheet steel, 14 gauge, 0.0747 inch minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches below floor deck surface, bearing flange 3 inches wide, sealed watertight.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions prior to beginning work.

### **3.2 INSTALLATION**

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On concrete and masonry surfaces provide minimum 4 inch bearing.
- C. On steel supports provide minimum 3 inch bearing.
- D. At mechanically fastened male/female side laps fasten as noted on Structural Drawings.
- E. Weld deck in accordance with AWS D1.3/D1.3M.
- F. At deck openings greater than 18 inches x 18 inches or less and supporting members are spaced at 5 feet max, provide L3X3X1/4 frames between supporting members with angles on all four sides of opening. Vertical leg of angels may be coped to bear horizontal leg on supporting structure. Specified in Section 05 12 00.
- G. For larger openings, see structural drawings.
- H. Where deck (other than cellular deck electrical raceway) changes direction, install 6 inch minimum wide sheet steel cover plates, of same thickness as deck. Fusion weld 12 inches on center maximum.
- I. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- J. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- K. Close openings above walls and partitions perpendicular to deck flutes with double row of foam cell closures.
- L. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- M. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- N. Weld stud shear connectors through steel deck to structural members below.
- O. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

**END OF SECTION**

## SECTION 05 40 00 - COLD-FORMED METAL FRAMING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Formed steel stud exterior wall framing and interior wall framing.
- B. Formed steel joist and purlin framing and bridging.

#### 1.2 RELATED REQUIREMENTS

- A. Section 04 20 00 - Unit Masonry
- B. Section 05 31 00 - Steel Decking.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.
- D. Section 06 10 00 - Rough Carpentry: Wall sheathing.
- E. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.
- F. Section 09 22 16 - Non-Structural Metal Framing.

#### 1.3 DEFINITIONS

- A. General: See AISI S240 for definitions of terms used in this section.
- B. Connection: A combination of structural elements and joints used to transmit forces between two or more members.
- C. Connector: A device used to transmit forces between cold-formed steel structural members or between a cold-formed steel structural member and another structural element.

#### 1.4 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
- B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.
- C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing.
- D. AISI S310 - North American Standard for the Design of Profiled Steel Diaphragm Panels.
- E. AISI S400 - North American Standard for Seismic Design of Cold-Formed Steel Structural Systems.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- H. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
- I. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- J. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members.
- K. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
- M. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

#### 1.5 COORDINATION

- A. Coordinate all work with job site superintendent and all applicable trades.

- B. Coordinate with work of other sections that is to be installed in or adjacent to metal framing systems, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

## 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

## 1.7 ACTION SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's data on factory-made connectors and mechanical fasteners, showing compliance with requirements.
- C. Product Data: For lateral-force resisting systems, provide product data sheets on hold-down, showing compliance with requirements.
- D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
  - 1. Indicate stud and ceiling joist layout.
  - 2. Describe method for securing studs to tracks and for bolted framing connections.
- E. Delegated Design Submittal:
  - 1. Shop drawings signed and sealed by a professional structural engineer.
  - 2. Design calculations sufficient to demonstrate compliance with design criteria; signed and sealed by a qualified professional engineer.
  - 3. Details and calculations for factory-made connectors, signed and sealed by a professional structural engineer.
  - 4. Also include designs for all interior non-bearing walls taller than 14' and all interior non-bearing wall openings larger than 10'-0".
- F. Manufacturer's Installation Instructions: Provide installation instructions for connectors. Indicate special procedures, conditions requiring special attention.

## 1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

## 1.9 WARRANTY

- A. Provide minimum two (2) year warranty against defects for materials and installation, unless otherwise indicated.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Structural Framing - Metal Framing, Connectors, and Accessories:
  - 1. ClarkDietrich: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  - 2. MarinoWARE: [www.marinoware.com/#sle](http://www.marinoware.com/#sle).
  - 3. The Steel Network, Inc: [www.SteelNetwork.com/#sle](http://www.SteelNetwork.com/#sle).
  - 4. Simpson Strong-Tie (Conn: [www.strongtie.com/#sle](http://www.strongtie.com/#sle)).
  - 5. Telling Industries: [www.tellingindustries.com](http://www.tellingindustries.com)
  - 6. Substitutions: See Section 01 25 00 - Substitution Procedures.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Design Requirements: Design cold-formed framing systems, components and connectors to withstand specified design loads in compliance with ICC (IBC), ASCE 7, AISI S100, and AISI S240.



- B. Design Loads: As indicated on Drawings
- C. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
  - 1. Live load deflection meeting the following, unless otherwise indicated:
    - a. Floors: Maximum vertical deflection under live load of 1/480 of span.
    - b. Roofs: Maximum vertical deflection under live load of 1/240 of span.
    - c. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.
      - 1) Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height.
      - 2) Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
    - d. Interior Walls: Maximum horizontal deflection under a horizontal load of 5 lbf/sq. ft.
      - 1) Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height.
      - 2) Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
    - e. Design nonaxial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
    - f. Ceiling Joist Framing: Vertical deflection of 1/240 of the span for live loads and 1/240 for total loads of the span.
  - D. Design framing systems able to tolerate movement of components without damage or overstressing, sheathing failure, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
  - E. Design framing systems able to accommodate construction tolerances, clearances of intended openings, and live load deflection of primary building structural members as follows:
    - 1. Upward and Downward movement of 1/2 inch.
  - F. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
  - G. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and AISI S240.
  - H. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

### 2.3 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

### 2.4 FRAMING MATERIALS

- A. General: Structural products per ASTM C955 ; fabricated from ASTM A1003/A1003M and ASTM A653/A653M , SS Grade 33 steel sheet, with G60 hot-dipped galvanized coating; minimum yield strength 33 ksi and minimum tensile strength 45 ksi - Follow AISI S201.
- B. Studs and Track: Studs formed to channel, "C", or "Sigma" shape with punched web; U-shaped track in matching nominal width and compatible height.
  - 1. Gage and depth: As indicated on the drawings.
  - 2. Minimum Base-Metal Thickness: As required by design, 18 ga. minimum. Where backing metal panel construction, coordinate gauge requirements with metal panel supplier.
- C. Joist and Purlins: Formed to channel, "C" shaped.
  - 1. Gauge and depth: As required to meet specified performance levels.
  - 2. Minimum Base-Metal Thickness: As required by design, 18 ga. minimum. Where backing metal panel construction, coordinate gauge requirements with metal panel supplier

### 2.5 STRUCTURAL FRAMING COMPONENTS

- A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.

1. Structural Grade: As required to meet design criteria.
2. Thickness and Depth: Depth as indicated on the drawings; thickness and structural grade as required to meet design criteria.

## **2.6 LATERAL FORCE-RESISTING SYSTEMS**

- A. Curtain Wall Studs and Girts:
  1. Thickness and Depth: Depth as indicated on the drawings; thickness and structural grade as required to meet design criteria.

## **2.7 CONNECTIONS**

- A. Performance Requirements: Provide connections in compliance with requirements of AISI S240.
- B. Structural Performance: Maintain load and movement capacity required by applicable building code and specified design criteria.
- C. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where required.
- D. Fixed Connections: Provide non-movement devices for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

## **2.8 MISCELLANEOUS CONNECTIONS AND FASTENERS**

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.
- C. Welding: Comply with AWS D1.1/D1.1M.

## **2.9 ACCESSORIES**

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

### **3.2 INSTALLATION - GENERAL**

- A. Install structural members and connections in compliance with ASTM C1007.

### **3.3 INSTALLATION OF STUDS**

- A. Install components in accordance with manufacturers' instructions and ASTM C 1007 requirements.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
- C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.

- D. Construct corners using minimum of three studs. Install minimum double studs at wall openings, door and window jambs.
- E. Install load-bearing studs full length in one piece. Splicing of studs is not permitted. Load bearing studs to fit tight into top and bottom track. 1/16 inch maximum gap between stud and track webs.
- F. Install load-bearing studs; brace, and reinforce to develop full strength and achieve design requirements.
- G. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- H. Install intermediate studs above and below openings to align with wall stud spacing.
- I. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.
- J. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- K. Touch-up field welds and damaged corrosion protected surfaces with primer.

### **3.4 INSTALLATION OF JOISTS AND PURLINS**

- A. Install framing components in accordance with manufacturer's instructions.
- B. Make provisions for erection stresses. Provide temporary alignment and bracing.
- C. Place joists at a minimum of 24 inches on center; not more than 2 inches from abutting walls, and connect joists to supports using fastener method.
- D. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.
- E. Locate joist end bearing directly over load-bearing studs or provide load distribution on top of stud track, unless otherwise noted.
- F. Touch-up field welds and damaged primed surfaces with primer.

### **3.5 FIELD QUALITY CONTROL**

- A. See Section 01 45 33 - Code-Required Special Inspections and Procedures, for additional requirements.

### **3.6 TOLERANCES**

- A. Studs - Vertical Alignment (Plumbness): 1/960 of span or 1/8 inch in 10 ft, in accordance with ASTM C1007.
- B. Studs - Maximum Variation from True Position: 1/8 inch in accordance with ASTM C1007.
- C. Stud Spacing: 1/8 inch from the designated spacing, provided that the cumulative error does not exceed the requirements of the finishing materials in accordance with ASTM C1007.

**END OF SECTION**



## SECTION 05 73 11 - DECORATIVE METAL AND GLAZED METAL RAILINGS - HDI

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Railing systems.

#### 1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes.
- C. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- F. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- G. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- I. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel.
- J. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:
  - 1. Contractor.
  - 2. Manufacturer's representative.
  - 3. Architect.
  - 4. Owner's representative.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's product data, including description of materials, components, and finishes.
- C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor locations, transitions, and terminations.
- D. Structural calculations prepared by a professional engineer licensed in the State in which the Project is located showing structural compliance with applicable building codes, based on final shop drawings and documents.
- E. Manufacturer's qualification statement.
- F. Single-source qualification statement.
- G. Installer's qualification statement.
- H. Maintenance Data: Manufacturer's instructions for care and cleaning.
- I. Executed warranty.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with no less than 20 years of documented experience.

- B. Installer Qualifications: Factory authorized subcontract installer.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in factory-provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Replace damaged items.
- D. Prior to installation, store materials and components under cover in dry location.

## **1.7 FIELD CONDITIONS**

- A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F and maximum 95 degrees F.
- B. Maintain ambient temperature of space at minimum 65 degrees F and maximum 95 degrees F for 24 hours before, during, and after railing installation.

## **1.8 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Manufacturer's standard 1-year warranty against defects in materials, fabrication, finishes, and installation. Complete forms in Owner's name and register with manufacturer.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURER**

- A. HDI Railing Systems: [www.handrail-design.com/#sle](http://www.handrail-design.com/#sle).
- B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

### **2.2 RAILING SYSTEMS, GENERAL**

- A. Factory- or shop-fabricate to suit project conditions, for proper connection to building structure, and in largest practical sizes for delivery to site.
- B. Handrails: Comply with applicable accessibility requirements of ADA Standards.
- C. Joints: Tightly fitted and secured, machined smooth with hairline seams.
- D. Field Connections: Provide sleeves, anchors, and other devices required for site assembly and installation.
- E. Welded Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.

### **2.3 METAL RAILINGS**

- A. Engineered, post-supported railing system with metal or glass infill.
  - 1. Product: HDI Railing Systems; Konic: [www.handrail-design.com/#sle](http://www.handrail-design.com/#sle).
  - 2. End and Intermediate Posts: Stainless steel; elliptical profile, configuration shown on drawings.
  - 3. Post Attachment: Surface.
  - 4. Grip Rail: Round, stainless steel, 1-1/2-inch diameter, 5/64" wall thickness.
  - 5. Handrail Brackets: Metal and finish to match railing.
  - 6. Infill: Stainless steel cable rail and cable hardware system.
  - 7. Fasteners: Concealed.

### **2.4 MATERIALS AND FINISHES**

- A. Stainless Steel Components:
  - 1. ASTM A666, Type 304.
  - 2. Stainless Steel Tubing: ASTM A554, Type 304.
  - 3. Stainless Steel Bars, Shapes, and Moldings: ASTM A276/A276M, Type 304.

4. Stainless Steel Finish: 240 grain.
- B. Stainless Steel cable rails and cable hardware.
- C. Stainless steel, type 316, wire rope provided by HDI Railing Systems. 3/16" diameter stranded wire with stainless steel thread adjusters and end stops.
- D. Cables
  1. Material: 7x9 Type 316 stainless steel stranded.
  2. Diameter: 3/16 inch diameter cable with a minimum breaking strength of 13KN.
  3. Finish: Mill
  4. Orientation: As indicated on the Contract Drawings.
  5. Spacing: As indicated on the Contract Drawings (max 3-1/8 inch)
- E. Cable Hardware Components:
  1. Material: Stainless steel, AISI 316L; Swaged hardware at end of cable.
  2. Hardware: Concealed inside end posts where practical.
  3. To comply with HDI Railing Systems' design criteria.
  4. Types of Fittings: Radius head internal thread adjuster, External thread swaged end.
- F. Wood for Railings:
  1. Species: Maple.
  2. Finish: Unstained.

## 2.5 ACCESSORIES

- A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated.
  1. For anchorage to concrete, provide anchors capable of sustaining, without failure, a load equal to four times the load imposed when installed in concrete, tested in accordance with ASTM E488/E488M. Provide inserts to cast into concrete for bolt anchors.
  2. For anchorage to structural steel, provide 24-inch center-to-center hole spacing; 1/2-inch, stainless steel, socket head cap screws for drilled and tapped or drilled and bolted attachment; provide anchors capable of sustaining, without failure, a load equal to four times the load imposed on the assembly.
  3. For anchorage to masonry, provide brackets to embed in masonry for bolt anchors.
  4. For anchorage to stud walls, provide backing plates for bolt anchors.
  5. Posts: Provide adjustable flanged brackets.
- B. Hydraulic Expansion Cement: ASTM C1107/C1107M.
- C. Concrete Adhesive Type Anchors: Comply with ICC-ES AC308.
- D. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015-inch dry film thickness per coat.
- E. Sealant: Silicone, black.
- F. Finish Touch-Up Materials: As recommended by manufacturer for field application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Verify anchoring devices and reinforcement are correct type, located correctly, and installed correctly.
- D. Notify Architect immediately of conditions that would prevent satisfactory installation.
- E. Do not proceed with work until detrimental conditions have been corrected.

- F. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

### **3.2 PREPARATION**

- A. Protect existing work.
- B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.
- C. Clean surfaces to receive units. Remove materials and substances detrimental to installation.

### **3.3 INSTALLATION**

- A. Use manufacturer's approved installer.
- B. Comply with manufacturer's drawings and written instructions.
- C. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.
- D. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Anchor securely to structure.
- F. Conceal anchor bolts and screws whenever possible.
- G. Weld connections that cannot be shop-welded due to size limitations.
  - 1. Weld in accordance with AWS D1.1/D1.1M.
  - 2. Weld stainless steel in accordance with AWS D1.6/D1.6M.
  - 3. Field-welding by certified welder.
  - 4. Match shop-welding and bolting.
  - 5. Clean welds, bolted connections, and abraded areas.
  - 6. Touch up shop primer and factory-applied finishes.
  - 7. Repair galvanizing with galvanizing repair paint in accordance with ASTM A780/A780M.
- H. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

### **3.4 TOLERANCES**

- A. Maximum Variation from Plumb: 1/4 inch.
- B. Maximum Offset from True Alignment: 1/4 inch per 50 feet of railing, noncumulative.
- C. Maximum Out-of-Position: 1/4 inch.

### **3.5 FIELD QUALITY CONTROL**

- A. Field Services: Provide services of manufacturer for field observation of installation of railings.

### **3.6 CLEANING**

- A. Metal: Clean exposed metal finishes with cloth moistened with potable water, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage material or finish.

### **3.7 PROTECTION**

- A. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
  - 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

**END OF SECTION**



## SECTION 06 10 00 - ROUGH CARPENTRY

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Roofing nailers.
- B. Roofing cant strips.
- C. Preservative treated wood materials.
- D. Fire retardant treated wood materials.
- E. Concealed wood blocking, nailers, and supports.
- F. Miscellaneous wood nailers, furring, and grounds.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.
- E. Section 07 72 00 - Roof Accessories: Prefabricated roof curbs.
- F. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- D. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- E. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- F. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- G. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
- H. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- I. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- K. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings.
- L. AWPA U1 - Use Category System: User Specification for Treated Wood.
- M. ICC (IBC) - International Building Code.
- N. ICC (IECC) - International Energy Conservation Code.
- O. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers.

- P. ICC-ES AC310 - Acceptance Criteria for Water-Resistive Membranes Factory-Bonded to Wood-Based Structural Sheathing, Used as Water-Resistive Barriers.
- Q. PS 2 - Performance Standard for Wood Structural Panels.
- R. PS 20 - American Softwood Lumber Standard.
- S. SPIB (GR) - Standard Grading Rules.
- T. UL 263 - Standard for Fire Tests of Building Construction and Materials.
- U. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- D. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

#### **1.6 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

### **PART 2 PRODUCTS**

#### **2.1 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. Species: Spruce-Pine-Fir, NGLA, unless otherwise indicated.
  - 2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
  - 3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at [www.alsc.org](http://www.alsc.org), and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
  - 4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

#### **2.2 DIMENSION LUMBER**

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: Kiln-dry or MC15.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Standard or No. 3.

#### **2.3 STRUCTURAL COMPOSITE LUMBER**

- A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
  - 1. Columns: Use parallel strand lumber with manufacturer's published modulus of elasticity, E: 2,000,000 psi, minimum. Fc (Pr||) 2500 psi, minimum.

2. Beams: Use laminated veneer lumber or parallel strand lumber with manufacturer's published modulus of elasticity, E: 2,000,000 psi, minimum. Fb: 2600 psi, minimum
3. Materials: StrandGuard TimberStrand LSL 1.30E Engineered Lumber, ICC ESR-1387.
  - a. Treatment: Zinc borate through complete cross section.
  - b. Bending Strength: 1900 psi.
  - c. Tensile Strength: 1075 psi.
  - d. Shear Strength: 150 psi.
  - e. Compression - Perpendicular to Grain: 670 psi.
  - f. Specific Gravity: 0.50 into the face, 0.42 into the edge.
  - g. R-value of 1-1/2 inch thickness (ASTM E 518): 1.86.

## 2.4 CONSTRUCTION PANELS

- A. Roof Sheathing: PS 2 type, rated Plywood
  1. Bond Classification: Exterior.
  2. Span Rating: 40/20.
  3. Performance Category: 5/8 PERF CAT.
- B. Roof Sheathing: Oriented strand board wood structural panel; PS 2.
  1. Grade: Sheathing.
  2. Bond Classification: Exposure 1.
  3. Performance Category: 5/8 PERF CAT.
  4. Span Rating: 40/20.
  5. Edges: Square.
  6. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 500 days.
  7. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
- C. Wall Sheathing: Plywood, PS 2 type.
  1. Bond Classification: Exterior.
  2. Grade: Sheathing.
  3. Span Rating: 24.
  4. Performance Category: 1/2 PERF CAT.
  5. Edge Profile: Square edge.
- D. Wall Sheathing: Gypsum, complying with requirements of ASTM C1396/C1396M for gypsum sheathing, V-shaped long edges, 5/8 inch Type X fire resistant.
- E. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.
  1. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Edges: Square.
  4. Products:
    - a. CertainTeed Corporation; GlasRoc Brand: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
    - b. Georgia-Pacific Gypsum; DensGlass Sheathing: [www.gpgypsum.com/#sle](http://www.gpgypsum.com/#sle).
    - c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: [www.goldbondbuilding.com/#sle](http://www.goldbondbuilding.com/#sle).
    - d. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Regular 5/8 in. (15.9 mm): [www.usg.com/#sle](http://www.usg.com/#sle).
    - e. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode USGX 5/8 in. (15.9 mm): [www.usg.com/#sle](http://www.usg.com/#sle).
    - f. USG Corporation; Securock Brand Glass-Mat Sheathing Regular 5/8 in. (15.9 mm): [www.usg.com/#sle](http://www.usg.com/#sle).

- g. USG Corporation; Securock Brand Glass-Mat Sheathing Firecode SHX 5/8 in. (15.9 mm): [www.usg.com/#sle](http://www.usg.com/#sle).
  - h. Substitutions: See Section 01 25 00 - Substitution Procedures.
- F. Wall Sheathing: Oriented strand board wood structural panel; PS 2.
- 1. Grade: Sheathing.
  - 2. Bond Classification: Exposure 1.
  - 3. Performance Category: 1/2 PERF CAT.
  - 4. Span Rating: 32/16.
  - 5. Edges: Square.
  - 6. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.

## 2.5 ACCESSORIES

- A. Fasteners and Anchors:
- 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M or Type 304 stainless steel for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
  - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
  - 3. Anchors: Toggle bolt type for anchorage to hollow masonry.
  - 4. Power-Driven fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70
  - 5. Screws for fastening wood Structural panel to cold formed metal Framing: ASTM C954 except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
- 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
- C. Sill Flashing: See Section 07 62 00.
- D. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.
- E. General Purpose Construction Adhesives: Comply with ASTM C557.
- F. Water-Resistive Barrier: See Section 07 25 00.
- G. Vapor Retarder: See Section 07 26 00.
- H. Air Barrier: See Section 07 27 00.

## 2.6 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
- 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
  - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:

1. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
    - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    - b. Do not use treated wood in direct contact with the ground.
  2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
    - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    - b. Treat rough carpentry items as indicated .
    - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
1. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A.
    - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
    - b. Treat lumber exposed to weather.
    - c. Treat lumber in contact with roofing, flashing, or waterproofing.
    - d. Treat lumber in contact with masonry or concrete.
    - e. Treat lumber in other locations as indicated.
  2. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
    - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

### **3.2 INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

### **3.3 FRAMING INSTALLATION**

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.

- E. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- G. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

### **3.4 BLOCKING, NAILERS, AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- D. Provide the following specific nonstructural framing and blocking:
  - 1. Cabinets and shelf supports.
  - 2. Wall brackets.
  - 3. Handrails.
  - 4. Grab bars.
  - 5. Towel and bath accessories.
  - 6. Wall-mounted door stops.
  - 7. Chalkboards and marker boards.
  - 8. Wall paneling and trim.
  - 9. Joints of rigid wall coverings that occur between studs.

### **3.5 ROOF-RELATED CARPENTRY**

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

### **3.6 INSTALLATION OF CONSTRUCTION PANELS**

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
  - 1. At long edges use sheathing clips where joints occur between roof framing members.
  - 2. Nail panels to framing; staples are not permitted.
- C. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails.
  - 1. Install plywood wall sheathing in accordance with manufacturer's current ICC-ES evaluation report for specified sheathing product.
  - 2. Use plywood or other acceptable structural panels at building corners, for not less than 48 inches, measured horizontally.
  - 3. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.
- D. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
  - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.



2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.

### **3.7 SITE APPLIED WOOD TREATMENT**

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

### **3.8 TOLERANCES**

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

### **3.9 CLEANING**

- A. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- B. Prevent sawdust and wood shavings from entering the storm drainage system.

**END OF SECTION**





## **SECTION 06 16 00 - SHEATHING - DUP**

### **PART 2 PRODUCTS**

#### **1.1 MANUFACTURERS**

- A. DuPont de Nemours, Inc: [www.dupont.com/#sle](http://www.dupont.com/#sle).
- B. Source Limitations: Provide sheathing products from single manufacturer.

#### **1.2 INSULATING SHEATHING**

- A. Description: Composite panels composed of foam insulation fused to MgO panels with factory-applied air- and water-resistive barrier.

**END OF SECTION**





## **SECTION 06 20 00 - FINISH CARPENTRY**

### **PART 2 PRODUCTS**

#### **1.1 FINISH CARPENTRY ITEMS**

#### **1.2 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting.  
Provide trim for scribing and site cutting.

**END OF SECTION**



## SECTION 07 21 00 - THERMAL INSULATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, and exterior wall behind masonry wall finish.
- B. Batt insulation in exterior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.

#### 1.3 DEFINITIONS

- A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
  - 1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
  - 2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
  - 3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

#### 1.4 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- E. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

- F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on project site during and after installation. Present on-site documentation upon request.

## 1.6 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); [www.airbarrier.org/#sle](http://www.airbarrier.org/#sle):
  1. Installer Qualification: Use accredited contractors, certified installers, evaluated materials, and third-party field quality control audit.
  2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

## 1.7 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

## PART 2 PRODUCTS

### 2.1 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
- D. Acoustical Insulation in Framed Walls: Acoustical batt insulation.
- E. Insulation in Wood Framed Walls: Batt insulation.

### 2.2 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
  1. Type and Compressive Resistance:
    - a. Type IV, 25 psi (173 kPa) - Wall Locations: All locations unless otherwise noted
    - b. Type VI, 40 psi (276 kPa) - Floor Locations: Radiant floor slabs/radiant heat piping plus 12 inches beyond the piping minimum.
  2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
  4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
    - a. Minimum R-Values:
      - 1) Foundation Wall: R15 minimum, thickness and depth as shown on the Drawings
      - 2) Walls: SEE NOTE!
      - 3) Floor: R-5
  5. Board Edges: Square.
  6. Products:
    - a. DuPont de Nemours, Inc; Styrofoam Brand Square Edge: [building.dupont.com/#sle](http://building.dupont.com/#sle).
    - b. Kingspan Insulation LLC; GreenGuard GG25-LG XPS Insulation Board: [www.kingspan.com/#sle](http://www.kingspan.com/#sle).
    - c. Owens Corning Corporation; FOAMULAR Type NGX 250 Extruded Polystyrene (XPS) Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
    - d. Substitutions: See Section 01 25 00 - Substitution Procedures.
- B. Extruded Polystyrene (XPS) Continuous Insulation (CI) Board: Comply with ASTM C578, and manufactured using carbon black technology.
  1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

3. Type and Thermal Resistance, R-value: Type IV, 5.6 (0.98), minimum, per 1 inch thickness at 75 degrees F mean temperature.
4. Minimum R-Values:
  - a. Foundation Wall: R15 minimum, thickness and depth as shown on the Drawings
  - b. Walls: R-19 minimum.
  - c. Floor: R-5 minimum.
5. Board Size: 48 inch by 96 inch.
6. Board Thickness: 1-3/4 inch.
7. Board Edges: Shiplap, at long edges.

### **2.3 MINERAL FIBER BOARD INSULATION MATERIALS**

- A. Mineral Wool Block, Board, or Blanket Thermal Insulation: Complying with ASTM C612 or ASTM C553.
  1. Where indicated, provide mineral fiber facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
  3. Products:
    - a. Johns Manville; MinWool 40 Curtainwall: [www.jm.com/#sle](http://www.jm.com/#sle).
    - b. ROCKWOOL; CURTAINROCK 80: [www.rockwool.com/#sle](http://www.rockwool.com/#sle).
    - c. ROCKWOOL; CURTAINROCK 40: [www.rockwool.com/#sle](http://www.rockwool.com/#sle).
    - d. Thermafiber, Inc; FireSpan 90: [www.thermafiber.com/#sle](http://www.thermafiber.com/#sle).

### **2.4 MINERAL FIBER BLANKET INSULATION MATERIALS**

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
  1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
  2. Facing: Aluminum foil, flame spread 25 rated; one side.
  3. Products:
    - a. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
    - b. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
    - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
    - d. Substitutions: See Section 01 25 00 - Substitution Procedures
- B. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
  1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
  2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
  3. Thermal Resistance: "R" value for insulation only, as follows: 3 1/2 inch thickness = R-11, 6 1/4 inch thickness = R-19, 12 inch thickness = R-38.
  4. Products:
    - a. Johns Manville; MinWool Sound Attenuation Fire Batts: [www.jm.com/#sle](http://www.jm.com/#sle).
    - b. ROCKWOOL; COMFORTBATT: [www.rockwool.com/#sle](http://www.rockwool.com/#sle).
    - c. ROCKWOOL; AFB: [www.rockwool.com/#sle](http://www.rockwool.com/#sle).
    - d. ROCKWOOL; AFB evo™: [www.rockwool.com/#sle](http://www.rockwool.com/#sle).
    - e. Thermafiber, Inc; SAFB: [www.thermafiber.com/#sle](http://www.thermafiber.com/#sle).
    - f. Thermafiber, Inc; SAFB FF: [www.thermafiber.com/#sle](http://www.thermafiber.com/#sle).
    - g. Substitutions: See Section 01 25 00 - Substitution Procedures

### **2.5 MINERAL FIBER BLANKET SOUND ATTENUATING INSULATION**

- A. Flexible Glass Fiber Blanket Sound Attenuation Insulation
  1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84 ASTM4.
  2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84 .

3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
  4. Location: Stud walls where shown on the Drawings
  5. Thickness: Full thickness of stud framing.
  6. Products:
    - a. CertainTeed Corporation; NoiseReducer Sound Attenuation Batts : [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
    - b. Johns Manville; Formaldehyde-Free Batts : [www.jm.com/#sle](http://www.jm.com/#sle).
    - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  7. Substitutions: See Section 01 25 00 - Substitution Procedures
- B. Mineral Wool Blanket Sound Attenuation Insulation**
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84 ASTM4.
  2. Smoke Developed Index: 0 or less, when tested in accordance with ASTM E84 .
  3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.
  4. Thickness: Full thickness of stud framing.
  5. Location: Stud walls where shown on the Drawings.
  6. Products:
    - a. Rockwool, Rockwool AFB Acoustical Fire Batt
    - b. Johns Manville; a Berkshire Hathaway company; MinWool Sound Attenuation Fire Batt.
    - c. Thermafiber, Inc.; an Owens Corning company; SAFB (Sound Attenuation Fire Blankets).

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

### **3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER**

- A. Adhere a 6 inches wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
  1. Tape seal joints.
  2. Extend sheet full height of joint.
- B. Install boards horizontally on foundation perimeter.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### **3.3 BOARD INSTALLATION UNDER CONCRETE SLABS**

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

### **3.4 BATT INSTALLATION**

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.





- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. At wood framing, place vapor retarder on warm side of insulation by stapling at 6 inches on center. Lap and seal sheet retarder joints over face of member.
- F. Tape seal tears or cuts in vapor retarder.
- G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane; tape seal in place.

### **3.5 PROTECTION**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION**



## SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Foamed-in-place insulation.
  - 1. In masonry cavity walls.
  - 2. In exterior framed walls.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.
- F. FM 4880 - Evaluating the Fire Performance of Insulated Building Panel Assemblies and Interior Finish Materials.
- G. NFPA 275 - Standard Method of Fire Tests for the Evaluation of Thermal Barriers.
- H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.
- I. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- J. UL 1040 - Standard for Safety Fire Test of Insulated Wall Construction.
- K. UL 1715 - Standard for Safety Fire Test of Interior Finish Material.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Certificates: Certify that products of this section meet or exceed specified requirements.
- D. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- E. Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

#### 1.5 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F of dew point.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Foamed-In-Place Insulation:
  - 1. BASF Corporation: [www.spf.basf.com/#sle](http://www.spf.basf.com/#sle).
  - 2. Carlisle Spray Foam Insulation: [www.carlisesfi.com/#sle](http://www.carlisesfi.com/#sle).
  - 3. Holcim (Gaco Western): [www.gaco.com/#sle](http://www.gaco.com/#sle).
  - 4. Huntsman Building Solutions: [www.huntsmanbuildingsolutions.com/#sle](http://www.huntsmanbuildingsolutions.com/#sle).
  - 5. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 6. NCFI Polyurethanes: [www.ncfi.com/#sle](http://www.ncfi.com/#sle).
  - 7. SWD Urethane, Mesa, AZ: [swdurethane.com](http://swdurethane.com).

### **2.2 MATERIALS**

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
  - 1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and fire protection requirements.
    - a. Comply with NFPA 285.
    - b. Fire Protection: Provide 15-minute thermal barrier of 1/2 inch gypsum board or equivalent material complying with NFPA 275 test method, or foamed-in-place insulation either exposed or with covering that complies with FM 4880, NFPA 286, UL 1040, or UL 1715.
  - 2. Thermal Resistance: R-value of 6.2, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
    - a. Minimum total resistance of foamed-in-place insulation to be SEE NOTE!; verify thickness with details on drawings.
  - 3. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
  - 4. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
  - 5. Air Permeance: 0.04 cfm per square foot, maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf.
  - 6. Closed Cell Content: At least 90 percent.
  - 7. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
  - 8. Products:
    - a. BASF Corporation; WALLTITE US: [www.spf.basf.com/#sle](http://www.spf.basf.com/#sle).
    - b. Carlisle Spray Foam Insulation; SealTite PRO One Zero: [www.carlisesfi.com/#sle](http://www.carlisesfi.com/#sle).
    - c. Holcim (Gaco Western LLC); Gaco 183M: [www.gaco.com/#sle](http://www.gaco.com/#sle).
    - d. Huntsman Building Solutions; Heatlok HFO Pro: [www.huntsmanbuildingsolutions.com/#sle](http://www.huntsmanbuildingsolutions.com/#sle).
    - e. Johns Manville; JM Corbond IV Closed Cell Spray Polyurethane Foam: [www.jm.com/#sle](http://www.jm.com/#sle).
    - f. NCFI Polyurethanes; a division of Barnhardt Manufacturing Company; NCFI InsulBloc Commercial Smart SPF Insulation System 11-037.
    - g. SWD Urethane, Mesa, AZ; Quik-Shield 144 Low GWP.
  - 9. Location:
    - a. Cavity Wall Construction: To be provided on the face of the block or sheathing in cavity wall construction.

### **2.3 ACCESSORIES**

- A. Primer: As required by insulation manufacturer.



## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify work within construction spaces or crevices is complete before insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

### **3.2 PREPARATION**

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

### **3.3 APPLICATION**

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Patch damaged areas.
- D. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

### **3.4 FIELD QUALITY CONTROL**

- A. Field inspections and tests will be performed by an independent testing agency.

### **3.5 PROTECTION**

- A. Do not permit subsequent construction work to disturb applied insulation.

**END OF SECTION**



## SECTION 07 21 29 - SPRAYED INSULATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fiberglass insulation applied to underside of structure.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C739 - Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation.
- B. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on materials, describing insulation properties.
- C. Certificates: Certify that products of this section meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- E. Installer's Qualification Statement.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.5 FIELD CONDITIONS

- A. Maintain acceptable ambient and substrate surface temperatures prior to, during, and after installation of primer and insulation materials and overcoat.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Exposed Cellulosic Fiber Sprayed Insulation:
  - 1. International Cellulose Corporation; K-13 Thermal Insulation: [www.spray-on.com/#sle](http://www.spray-on.com/#sle).
  - 2. Isolatek International Corp; CAFCO CELLU-SHIELD: [www.isolatek.com/#sle](http://www.isolatek.com/#sle).
  - 3. Johns Manville Spider: [www.jm.com](http://www.jm.com).
  - 4. Monoglass Inc; [www.monoglass.com](http://www.monoglass.com); sales representative: Jim Hunter of Hunter & Swasey, 734.604.1074.
  - 5. Substitutions: See Section 01 25 00 - Substitution Procedures.

#### 2.2 MATERIALS

- A. Cellulosic Fiber Acoustical Insulation: ASTM C739; treated cellulosic fiber.
  - 1. Density: 2 pcf, when tested in accordance with ASTM D1622.
  - 2. Noise Reduction Coefficient (NRC): .90 for 1.5" thickness.
  - 3. Moisture Absorption: Maximum 15 percent by weight.
  - 4. Flame Spread / Smoke Developed Index: 0-25 / 0-450, Class A, when tested in accordance with ASTM E84.
  - 5. Combustibility: Passing ASTM E136.
  - 6. Color: As selected from manufacturer's standard color chart.
  - 7. Location: Where noted on drawings

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that surfaces are clean, dry, and free of matter that may inhibit adhesion.
- B. Verify that ceiling hangers and supporting clips have been installed correctly.
- C. Verify other work on and within spaces to be insulated is complete prior to application.

### **3.2 PREPARATION**

- A. Mask and protect adjacent surfaces from overspray or damage.
- B. Apply primer in accordance with manufacturer's instructions.
- C. Install insulation stops between rafters at wall/sloped roof construction to prevent insulation from covering soffit vents or from limiting air circulation from soffit to attic space.

### **3.3 INSTALLATION**

- A. Install sprayed insulation in accordance with manufacturer's instructions.
- B. Install sprayed insulation to a uniform monolithic density without voids.
- C. Install to a minimum cured thickness as noted on drawings.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspection will include verification of sprayed insulation thickness and density.

### **3.5 PROTECTION**

- A. Do not permit subsequent construction work to disturb applied sprayed insulation.

**END OF SECTION**



## SECTION 07 25 00 - WEATHER BARRIERS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Water-resistive barriers.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Water-resistive barrier under exterior cladding.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

#### 1.3 DEFINITIONS

- A. Weather Barriers: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Water-Resistive Barrier: A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.

#### 1.4 REFERENCE STANDARDS

- A. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- B. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis of Design: Tyvek Commercial by DuPont.
  - 1. Spunbonded olefin, non-woven, non-perforated.
  - 2. Performance Characteristics:
    - a. ASTM E-1677 Type 1 Air Retarder: Air leakage at 25 mph (u5 Pa) wind pressure of less than .06 fcm/ft<sup>2</sup>.
    - b. Water Vapor Transmission of greater than 28 perms in accordance with ASTM E-69-90, Method B.
    - c. Water penetration resistance of 200 cm minimum in accordance with AATCC-127.
  - 3. Sealing Tape / Fasteners:
    - a. DuPont Contractor Tape.
    - b. Recommended Fasteners for Wood: Nails with plastic washer heads.
    - c. Recommended Fasteners for Steel Frame construction: Screws with washers.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.

#### 3.2 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

**END OF SECTION**



## SECTION 07 42 13 - METAL WALL PANELS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Manufactured metal panels for exterior wall panels, interior liner panels, retrofit panels, and subgirt framing assembly, with insulation, related flashings, and accessory components.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Wall panel substrate.
- B. Section 06 10 00 - Rough Carpentry: Wall panel substrate.
- C. Section 07 21 00 - Thermal Insulation.
- D. Section 07 25 00 - Weather Barriers: Weather barrier under wall panels.
- E. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

#### 1.3 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

#### 1.4 SUBMITTALS

- A. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
  - 1. Physical characteristics of components shown on shop drawings.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation instructions and recommendations.
- B. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.
- C. Samples: Submit two samples of wall panel and soffit panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.
- F. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

- B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

### 1.7 FIELD CONDITIONS

- A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

### 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.
- C. Special Warranty: Provide 2-year warranty covering water tightness and integrity of seals of metal wall panels. Complete forms in Owner's name and register with warrantor.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Metal Wall Panels - Concealed Fasteners:
  - 1. ATAS International, Inc: [www.atas.com/#sle](http://www.atas.com/#sle).
  - 2. Centria, a Nucor Company: [www.centria.com/#sle](http://www.centria.com/#sle).
  - 3. MBCI: [www.mbc.com/#sle](http://www.mbc.com/#sle).
  - 4. Morin Corporation: [www.morincorp.com/#sle](http://www.morincorp.com/#sle).
  - 5. Petersen Aluminum Corporation: [www.pac-clad.com/#sle](http://www.pac-clad.com/#sle).

### 2.2 METAL WALL PANEL SYSTEM

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
  - 1. Provide exterior wall panels, soffit panels, retrofit wall panels, and subgirt framing assembly.
  - 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
  - 3. Design Pressure: In accordance with applicable codes.
  - 4. Maximum Allowable Deflection of Panel:  $L/180$  for length(L) of span.
  - 5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
  - 6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
  - 7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
  - 8. Corners: Factory-fabricated in one continuous piece with minimum 2-inch returns.
- B. Exterior Wall Panels:
  - 1. Profile: Vertical; Solid style.
  - 2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
  - 3. Material: Precoated steel sheet, 22 gauge, 0.0299 inch minimum thickness.
  - 4. Panel Width: 48 inches.
  - 5. Color: As selected by Architect from manufacturer's standard line.
- C. Subgirt Framing Assembly:
- D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

- F. Anchors: Galvanized steel.

## 2.3 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- B. Precoated Aluminum Sheet: ASTM B209/B209M, 3105 alloy, O temper, with smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
- C. Stainless Steel Sheet ASTM A240/A240M Type 304 fully annealed.

## 2.4 FINISHES

- A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss as selected by Architect from manufacturer's standard line.
1. Products:
    - a. Arkema, Inc; Kynar 500: [www.arkema.com/#sle](http://www.arkema.com/#sle).
    - b. Beckers Group; Beckry Fluor: [www.beckers-group.com/#sle](http://www.beckers-group.com/#sle).
    - c. PPG; Duranar: [www.ppgmetalcoatings.com/#sle](http://www.ppgmetalcoatings.com/#sle).
    - d. Sherwin-Williams Company; Fluoropon: [www.coil.sherwin.com/#sle](http://www.coil.sherwin.com/#sle).

## 2.5 ACCESSORIES

- A. Support for Cladding and Continuous Insulation: Thermal clips.
1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
  2. Galvanized Steel Support Clip: 14 gauge, 0.0747 inch, G90/Z275 galvanized support clip complying with ASTM A653/A653M, with integral glass fiber reinforced polyamide thermal isolator pad.
  3. Stainless Steel Support Clip: 16 gauge, 0.0625 inch Type 304 stainless steel, with thermal isolator pad.
  4. Clip Depth: As required for thickness of insulation.
  5. Spacing of Clips: 16 inches on center, vertically.
  6. Fasteners: As recommended by clip manufacturer.
- B. Support for Cladding and Continuous Insulation: Continuous thermal Z-girts.
1. Fiberglass reinforced plastic (FRP) girts that provide cladding attachment support for exterior wall cladding, brick veneer, CMU veneer, metal wall panels, and siding.
  2. Depth: As required for thickness of insulation.
  3. Length: 6 inches for clips and 96 inches for girts.
  4. Spacing: 16 inches on center, vertically.
  5. Fasteners: As recommended by clip manufacturer.
- C. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- D. Concealed Sealants: Non-curing butyl sealant or tape sealant, see Section 07 92 00
- E. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.
1. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.
- F. Field Touch-up Paint: As recommended by panel manufacturer.
- G. Bituminous Paint: Asphalt base.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that building framing members are ready to receive panels.
- B. Verify weather barrier, see Section 07 25 00, has been installed over wall panel substrate; see Section 05 40 00.

### **3.2 PREPARATION**

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.

### **3.3 INSTALLATION**

- A. Install panels on walls and soffits in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint; allow to dry prior to wall panel installation.
- C. Shim or otherwise plumb substrates receiving metal panels to manufacturer's required flatness requirements.
- D. Locate joints over supports.
- E. Lap panel ends 2 inches, minimum.
- F. Provide expansion and control joints where indicated and per manufacturer's requirements.
- G. Use concealed fasteners unless otherwise indicated by Architect.
- H. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

### **3.4 TOLERANCES**

- A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch, maximum.

### **3.5 CLEANING**

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.

### **3.6 PROTECTION**

- A. Protect metal wall panels until completion of project.
- B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

**END OF SECTION**

## SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Pre-finished aluminum gutters and downspouts.

#### 1.2 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. SMACNA (ASMM) - Architectural Sheet Metal Manual.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Comply with applicable code for size and method of rain water discharge.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on prefabricated components.
- C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials that could cause discoloration, staining, or damage.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Gutters and Downspouts:
  - 1. Alside, Inc: [www.alside.com/#sle](http://www.alside.com/#sle).
  - 2. ATAS International, Inc: [www.atas.com/#sle](http://www.atas.com/#sle).
  - 3. Cheney Flashing Company: [www.cheneyflashing.com/#sle](http://www.cheneyflashing.com/#sle).
  - 4. Drexel Metals Inc: [www.drexmet.com/#sle](http://www.drexmet.com/#sle).
  - 5. Hickman Edge Systems; Wind Resistant Gutter: [www.hickmanedgesystems.com/#sle](http://www.hickmanedgesystems.com/#sle).
  - 6. Metal-Era Inc; Seal-Tite WR Gutter: [www.metallera.com/#sle](http://www.metallera.com/#sle).
  - 7. SAF Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc: [www.saf.com/persys/#sle](http://www.saf.com/persys/#sle).

#### 2.2 MATERIALS

- A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch thick base metal.
  - 1. Finish: Shop pre-coated with modified silicone coating.
  - 2. Color: As selected by Architect from manufacturer's standard colors.

#### 2.3 COMPONENTS

- A. Gutters: CDA rectangular style profile.
- B. Downspouts: CDA rectangular profile.
- C. Anchors and Supports: Profiled to suit gutters and downspouts.
  - 1. Anchoring Devices: In accordance with CDA requirements.
  - 2. Gutter Supports: Brackets.
  - 3. Downspout Supports: Brackets.

- D. Fasteners: Same material and finish as gutters and downspouts, with soft neoprene washers.

## **2.4 FABRICATION**

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

## **2.5 ACCESSORIES**

- A. Splash Pads: Precast concrete type, profiles size(s) as indicated; minimum 3,000 psi compressive strength at 28 days, with minimum 5 percent air entrainment.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

### **3.2 PREPARATION**

- A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

### **3.3 INSTALLATION**

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Sheet Metal: Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Slope gutters .05 inch per foot , .2 percent minimum.
- D. Connect downspouts to storm sewer system. Grout connection watertight.

**END OF SECTION**



## SECTION 07 72 00 - ROOF ACCESSORIES

### PART 1 GENERAL

#### 1.1 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Maintenance requirements.
- C. Warranty Documentation:
  - 1. Submit manufacturer warranty.
  - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.2 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

#### 1.3 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for Roof Hatch. Complete forms in Owner's name and register with manufacturer.

### PART 2 PRODUCTS

#### 2.1 ROOF CURBS

- A. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
  - 1. Roof Curb Mounting Substrate: Curb substrate consists of standing seam metal roof panel system.
  - 2. Sheet Metal Material:
    - a. Aluminum: 0.080 inch minimum thickness, with 3003 alloy, and H14 temper.
  - 3. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing system at 1:1 slope; minimum cant height 4 inches.
  - 4. Fabricate curb bottom and mounting flanges for installation directly on metal roof panel system to match slope and configuration of system.
    - a. Extend side flange to next adjacent roof panel seam and comply with seam configurations and seal connection, providing at least 6 inch clearance between curb and metal roof panel flange allowing water to properly flow past curb.
    - b. Where side of curb aligns with metal roof panel flange, attach fasteners on upper slope of flange to curb connection allowing water to flow past below fasteners, and seal connection.
    - c. Maintain at least 12 inch clearance from curb, and lap upper curb flange on underside of down sloping metal roof panel, and seal connection.
    - d. Lap lower curb flange overtop of down sloping metal roof panel and seal connection.
- B. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
  - 1. Provide preservative treated wood nailers along top of curb.
  - 2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
  - 3. Height Above Finished Roof Surface: 8 inches, minimum.

- C. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
- D. Pipe, Duct, or Conduit Mounting Curbs: Vertical posts, minimum 8 inches square unless otherwise indicated.

## **2.2 ROOF HATCHES AND VENTS**

- A. Roof Hatch Manufacturers:
  - 1. Activar Construction Products Group, Inc. - JL Industries: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
  - 2. Babcock-Davis; Personnel: [www.babcockdavis.com/#sle](http://www.babcockdavis.com/#sle).
  - 3. Bilco Company; Type TB (various types and special size): [www.bilco.com/#sle](http://www.bilco.com/#sle).
  - 4. Substitutions: See Section 01 25 00 - Substitution Procedures.
- B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
- C. Flat Roof Access Hatches with Ladder: Factory-assembled roof hatch with PVC frame and flat cover and folding metal access ladder, complete with operating and release hardware.
  - 1. Mounting Substrate: Provide frames and curbs suitable for mounting on flat roof deck sheathing with insulation.
  - 2. Thermally Broken Hatches: Provide insulation within hatch frame and cover.
  - 3. Folding Ladder Access: Triple section ladder, upper roof hatch door with PVC frame and lower insulated door with wood box to enclose and support ladder; 23-1/2 by 47 inches rough opening.
- D. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
  - 1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch thick.
  - 2. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
  - 3. Curb Height: 12 inches from finished surface of roof, minimum.
- E. Metal Covers: Flush, insulated, hollow metal construction.
  - 1. Capable of supporting 40 psf live load.
  - 2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch thick, liner 0.04 inch thick.
  - 3. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
  - 4. Gasket: Neoprene, continuous around cover perimeter.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

### **3.4 CLEANING**

- A. Clean installed work to like-new condition.

### **3.5 PROTECTION**

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

**END OF SECTION**



## SECTION 07 84 00 - FIRESTOPPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

#### 1.3 REFERENCE STANDARDS

- A. ASTM E90
- B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- C. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- D. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- E. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems.
- F. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- G. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus.
- H. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- J. ITS (DIR) - Directory of Listed Products.
- K. FM 4991 - Approval Standard of Firestop Contractors.
- L. FM (AG) - FM Approval Guide.
- M. SCAQMD 1168 - Adhesive and Sealant Applications.
- N. UL 1479 - Standard for Fire Tests of Penetration Firestops.
- O. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems.
- P. UL (DIR) - Online Certifications Directory.
- Q. UL (FRD) - Fire Resistance Directory.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Certificate from authority having jurisdiction indicating approval of materials used.
- H. Manufacturer's qualification statement.

- I. Installer's qualification statement.

## 1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
  2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
  3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
1. Trained by manufacturer.
  2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
  3. Verification of minimum three years documented experience installing work of this type.
  4. Verification of at least five satisfactorily completed projects of comparable size and type.
  5. Licensed by local authorities having jurisdiction (AHJ).

## 1.6 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Firestopping Manufacturers:
1. 3M Fire Protection Products: [www.3m.com/firestop/#sle](http://www.3m.com/firestop/#sle).
  2. Hilti, Inc: [www.hilti.com/#sle](http://www.hilti.com/#sle).
  3. RectorSeal, a CSW Industrials Company; Metacaulk 150+ General Purpose Firestop Sealant: [www.rectorseal.com/firestop-solutions/#sle](http://www.rectorseal.com/firestop-solutions/#sle).
  4. Specified Technologies Inc: [www.stifirestop.com/#sle](http://www.stifirestop.com/#sle).
  5. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).

### 2.2 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- E. Fire Ratings: Refer to drawings for required systems and ratings.

### 2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.

1. Movement: Provide systems that have been tested to show movement capability as indicated.
  2. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
  3. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
- B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
1. Movement: Provide systems that have been tested to show movement capability as indicated.
- C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
1. Movement: Provide systems that have been tested to show movement capability as indicated.
  2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
  3. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
  2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
  3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
  4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.
- E. Acoustically Rated Firestopping: Provide system tested in accordance with ASTM E90 with STC rating of 50, minimum.

## 2.4 FIRESTOPPING FOR PERIMETER CONTAINMENT

- A. Perimeter Joint Systems That Have Movement Capabilities (Dynamic-D):
1. 2 Hour Construction: UL System CW-D-1004; Specified Technologies Inc. AS200 Elastomeric Spray.
  2. 2 Hour Construction: UL System CW-D-1004; Specified Technologies Inc. Fast Tack Firestop Spray.
  3. 2 Hour Construction: UL System CW-D-1011; Specified Technologies Inc. Fast Tack Firestop Spray.
  4. 2 Hour Construction: Intertek System BP-120-03; RectorSeal MetaCaulk 1200 Spray.
  5. 2 Hour Construction: Intertek System BP-120-05; RectorSeal MetaCaulk 1200 Spray.
  6. 2 Hour Construction: Intertek System BP-120-09; RectorSeal MetaCaulk 1200 Spray.
  7. 2 Hour Construction: Intertek System BP-120-12; RectorSeal MetaCaulk 1200 Spray.
  8. 2 Hour Construction: Intertek System BP-120-14; RectorSeal MetaCaulk 1200 Spray.
  9. 2 Hour Construction: UL System CW-D-2014; RectorSeal MetaCaulk 1200 Spray.
  10. 2 Hour Construction: UL System CW-D-2016; RectorSeal MetaCaulk 1200 Spray.
  11. 2 Hour Construction: UL System CW-D-2018; RectorSeal MetaCaulk 1200 Spray.
  12. 2 Hour Construction: UL System CW-D-2042; Specified Technologies Inc. Fast Tack Firestop Spray.
  13. 2 Hour Construction: UL System CW-D-2047; RectorSeal MetaCaulk 1200 Spray.
  14. 2 Hour Construction: UL System CW-D-2049; RectorSeal MetaCaulk 1200 Spray.

## 2.5 FIRESTOPPING FOR FLOOR-TO-FLOOR, FLOOR-TO-WALL, HEAD-OF-WALL, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:
1. Floor-to-Floor Joints:

- a. 2 Hour Construction: UL System FF-D-0024; RectorSeal MetaCaulk 150+.
  - b. 2 Hour Construction: UL System FF-D-0053; RectorSeal MetaCaulk Joint Strip.
  - c. 2 Hour Construction: UL System FF-D-0084; RectorSeal MetaCaulk Joint Strip.
  - d. 2 Hour Construction: UL System FF-D-1013; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - e. 2 Hour Construction: UL System FF-D-1085; Tremco, TREMstop Acrylic Firestop Sealant.
2. Head-of-Wall Joints at Concrete/Concrete Masonry Wall to Concrete Over Metal Deck Floor:
- a. 2 Hour Construction: UL System HW-D-0039; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
  - b. 2 Hour Construction: UL System HW-D-0058; RectorSeal MetaCaulk 1200 Spray.
  - c. 2 Hour Construction: UL System HW-D-0149; RectorSeal MetaCaulk 150+.
  - d. 2 Hour Construction: UL System HW-D-0181; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - e. 2 Hour Construction: UL System HW-D-1037; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
3. Head-of-Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
- a. 2 Hour Construction: UL System HW-D-0268; Hilti CP 606 Flexible Firestop Sealant.
  - b. 2 Hour Construction: UL System HW-D-0312; Specified Technologies Inc. SIL Silicone Sealant.
4. Concrete/Concrete Masonry Wall-to-Wall Joint Systems That Have Movement Capabilities (Dynamic-D):
- a. 2 Hour Construction: UL System WW-D-0025; RectorSeal MetaCaulk 1200 Spray.
  - b. 2 Hour Construction: UL System WW-D-0027; RectorSeal MetaCaulk 150+.
  - c. 2 Hour Construction: UL System WW-D-0110; RectorSeal MetaCaulk 150+.
  - d. 2 Hour Construction: UL System WW-D-1077; Tremco, TREMstop Acrylic Firestop Sealant.
  - e. 2 Hour Construction: UL System WW-D-0017; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - f. 2 Hour Construction: UL System WW-D-0032; Hilti CP 606 Flexible Firestop Sealant.
- B. Gypsum Board Walls:
1. Wall-to-Wall Joints That Have Movement Capabilities (Dynamic-D):
    - a. 2 Hour Construction: UL System WW-D-0180; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
    - b. 2 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
    - c. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.
  2. Head-of-Wall Joints at Underside of Steel Beam and Concrete Over Metal Deck Floor with Sprayed On Fireproofing:
    - a. 2 Hour Construction: UL System HW-D-0252; Specified Technologies Inc. AS200 Elastomeric Spray.
    - b. 2 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
    - c. 1 Hour Construction: UL System HW-D-0259; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  3. Head-of-Wall Joints at Underside of Flat Concrete:
    - a. 2 Hour Construction: UL System HW-D-0044; Specified Technologies Inc. AS200 Elastomeric Spray.
    - b. 2 Hour Construction: UL System HW-D-0079; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
    - c. 2 Hour Construction: UL System HW-D-0371; Specified Technologies Inc. SpeedFlex Joint Profile System.



- d. 2 Hour Construction: UL System HW-D-0689; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
  - e. 2 Hour Construction: UL System HW-D-0696; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
  - f. 2 Hour Construction: UL System HW-D-0798; RectorSeal Blaze Foam.
  - g. 2 Hour Construction: UL System HW-D-1068; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - h. 2 Hour Construction: UL System HW-D-0757; Hilti CFS-TTS Top Track Seal.
  - i. 2 Hour Construction: UL System HW-D-0016; Tremco, TREMstop Acrylic Firestop Sealant.
  - j. 2 Hour Construction: UL System HW-D-0017; Tremco, TREMstop Acrylic Firestop Sealant.
  - k. 2 Hour Construction: UL System HW-D-1072; Tremco, TREMstop Acrylic Firestop Sealant.
  - l. 1 Hour Construction: UL System HW-D-0079; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
  - m. 1 Hour Construction: UL System HW-D-0371; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - n. 1 Hour Construction: UL System HW-D-0689; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
  - o. 1 Hour Construction: UL System HW-D-0696; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
  - p. 1 Hour Construction: UL System HW-D-1068; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - q. 1 Hour Construction: UL System HW-D-0757; Hilti CFS-TTS Top Track Seal.
  - r. 1 Hour Construction: UL System HW-D-0016; Tremco, TREMstop Acrylic Firestop Sealant.
4. Head-of-Wall Joints at Concrete Over Metal Deck:
- a. 2 Hour Construction: UL System HW-D-0034; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
  - b. 2 Hour Construction: UL System HW-D-0043; Specified Technologies Inc. AS200 Elastomeric Spray.
  - c. 2 Hour Construction: UL System HW-D-0099; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - d. 2 Hour Construction: UL System HW-D-0144; RectorSeal MetaCaulk 150+.
  - e. 2 Hour Construction: UL System HW-D-0363; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - f. 2 Hour Construction: UL System HW-D-0365; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - g. 2 Hour Construction: UL System HW-D-0548; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - h. 2 Hour Construction: UL System HW-D-0749; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
  - i. 2 Hour Construction: UL System HW-D-0256; Tremco, TREMstop Acrylic Firestop Sealant.
  - j. 1 Hour Construction: UL System HW-D-0034; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
  - k. 1 Hour Construction: UL System HW-D-0099; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - l. 1 Hour Construction: UL System HW-D-0363; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - m. 1 Hour Construction: UL System HW-D-0365; Specified Technologies Inc. SpeedFlex Joint Profile System.

- n. 1 Hour Construction: UL System HW-D-0548; Specified Technologies Inc. SpeedFlex Joint Profile System.
  - o. 1 Hour Construction: UL System HW-D-0749; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
  - p. 1 Hour Construction: UL System HW-D-0256; Tremco, TREMstop Acrylic Firestop Sealant.
5. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Parallel to Ribs:
- a. 2 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - b. 2 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
  - c. 1 Hour Construction: UL System HW-D-0049; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - d. 1 Hour Construction: UL System HW-D-0184; Hilti CP 606 Flexible Firestop Sealant.
6. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
- a. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
  - b. 2 Hour Construction: UL System HW-D-0103; Specified Technologies Inc. ES Elastomeric Firestop Sealant.
  - c. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
7. Head-of-Wall Joints at Concrete Over Metal Deck, Wall Perpendicular to Ribs, Not Cut to Fit:
- a. 2 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - b. 2 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.
  - c. 1 Hour Construction: UL System HW-D-0042; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
  - d. 1 Hour Construction: UL System HW-D-0045; Hilti CP 606 Flexible Firestop Sealant.

## 2.6 FIRESTOPPING FOR FLOOR-TO-WALL MOVABLE JOINTS

- A. Floor-To-Wall Joint System That Have Movement Capabilities (Dynamic-D):
- 1. 2 Hour Construction: UL System FW-D-1069; Tremco, TREMstop Acrylic Firestop Sealant.

## 2.7 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

- A. Blank Openings:
- 1. In Floors or Walls:
    - a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System C-AJ-0015; Specified Technologies Inc. SSM Mortar.
    - c. 2 Hour Construction: UL System C-AJ-0116; Specified Technologies Inc. Composite Sheet.
    - d. 2 Hour Construction: UL System C-AJ-0136; Specified Technologies Inc. SSM Mortar.
    - e. 2 Hour Construction: UL System C-AJ-0171; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
- B. Penetrations Through Floors or Walls By:
- 1. Multiple Penetrations in Large Openings:
    - a. 2 Hour Construction: UL System C-AJ-2863; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.

- c. 2 Hour Construction: UL System C-AJ-8035; Specified Technologies Inc. SSM Mortar.
  - d. 2 Hour Construction: UL System C-AJ-8042; RectorSeal MetaCaulk 1000.
  - e. 2 Hour Construction: UL System C-AJ-8055; Specified Technologies Inc. SSP Firestop Putty.
  - f. 2 Hour Construction: UL System C-AJ-8093; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
  - g. 2 Hour Construction: UL System C-AJ-8114; Specified Technologies Inc. SSM Mortar.
  - h. 2 Hour Construction: UL System C-AJ-8115; Specified Technologies Inc. SSM Mortar.
  - i. 2 Hour Construction: UL System C-AJ-8129; RectorSeal MetaCaulk 1200 Spray.
  - j. 2 Hour Construction: UL System C-AJ-8149; RectorSeal MetaCaulk 1000.
  - k. 2 Hour Construction: UL System C-AJ-8171; RectorSeal MetaCaulk Wrap Strip.
  - l. 2 Hour Construction: UL System C-AJ-8181; Specified Technologies Inc. Composite Sheet.
  - m. 2 Hour Construction: UL System C-AJ-8220; Specified Technologies Inc. SSM Mortar.
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
- a. 2 and 3 Hour Construction: UL System C-AJ-1696; HoldRite HydroFlame 200 Intumescent Firestop Sealant.
  - b. 2 Hour Construction: UL System C-AJ-1036; RectorSeal MetaCaulk 950.
  - c. 2 Hour Construction: UL System C-AJ-1090; Specified Technologies Inc. SSP Firestop Putty.
  - d. 2 Hour Construction: UL System C-AJ-1198; Specified Technologies Inc. SIL Silicone Sealant.
  - e. 2 Hour Construction: UL System C-AJ-1226; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - f. 2 Hour Construction: UL System C-AJ-1240; Specified Technologies Inc. LC Endothermic Firestop Sealant.
  - g. 2 Hour Construction: UL System C-AJ-1425; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
  - h. 1 Hour Construction: UL System C-AJ-1039; RectorSeal MetaCaulk 950.
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
- a. 2 and 3 Hour Construction: UL System C-AJ-2843; HoldRite HydroFlame Pipe Collar.
  - b. 2 Hour Construction: UL System C-AJ-2047; RectorSeal MetaCaulk 1000.
  - c. 2 Hour Construction: UL System C-AJ-2167; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - d. 2 Hour Construction: UL System C-AJ-2109; Hilti CP 643N/644 Firestop Collar.
  - e. 2 Hour Construction: UL System C-AJ-2106; Specified Technologies Inc. SSW Wrap Strips.
  - f. 2 Hour Construction: UL System C-AJ-2282; Specified Technologies Inc. SSW Wrap Strips.
  - g. 2 Hour Construction: UL System C-AJ-2297; Specified Technologies Inc. SSC Collars.
  - h. 2 Hour Construction: UL System C-AJ-2297; Specified Technologies Inc. SSW Wrap Strips.
  - i. 2 Hour Construction: UL System C-AJ-2298; Specified Technologies Inc. LCC Intumescent Firestop Collars.
  - j. 2 Hour Construction: UL System C-AJ-2348; RectorSeal MetaCaulk 150+.
  - k. 2 Hour Construction: UL System C-AJ-2588; Specified Technologies Inc. RTC Range-Taking Collar.

- I. 2 Hour Construction: UL System C-AJ-2707; RectorSeal MetaCaulk 1000.
      - m. 2 Hour Construction: UL System C-AJ-2772; Specified Technologies Inc. SSW Wrap Strips.
      - n. 2 Hour Construction: UL System C-BJ-2021; Hilti CP 643N Firestop Collar.
    - 4. Cable Trays with Electrical Cables:
      - a. 2 Hour Construction: UL System C-AJ-4094; Hilti CFS-BL Firestop Block.
    - 5. Insulated Pipes:
      - a. 2 Hour Construction: UL System C-AJ-5048; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CP 601S Elastomeric Firestop Sealant, CP 604 Self-Leveling Firestop Sealant or CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
      - b. 2 Hour Construction: UL System C-AJ-5087; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
      - c. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE IMAX Intumescent Firestop Sealant.
      - d. 2 Hour Construction: UL System C-AJ-5138; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
      - e. 2 Hour Construction: UL System C-AJ-5313; Specified Technologies Inc. LC Endothermic Firestop Sealant.
    - 6. HVAC Ducts, Uninsulated:
      - a. 2 Hour Construction: UL System C-AJ-7111; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- C. Penetrations Through Floors By:
  - 1. Multiple Penetrations in Large Openings:
    - a. 2 Hour Construction: UL System F-A-0021; RectorSeal Cast-in-Place Firestop Device.
    - b. 2 Hour Construction: UL System F-A-8012; Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or CFS-S SIL SL Firestop Silicone Sealant Self-Leveling.
  - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
    - a. 2 Hour Construction: UL System F-A-1110; Specified Technologies Inc. CID Cast-In Device.
    - b. 2 Hour Construction: UL System F-A-1129; Specified Technologies Inc. Closet Flange Firestop Gasket.
  - 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
    - a. 2 and 3 Hour Construction: UL System F-A-1133; HoldRite HydroFlame HFP-Px, HFP-PxB Cast-In Device.
    - b. 2 Hour Construction: UL System F-A-2213; Hilti CFS-DID Drop-In Device.
    - c. 2 Hour Construction: UL System F-A-2216; Specified Technologies Inc. Closet Flange Firestop Gasket.
    - d. 2 Hour Construction: UL System F-A-2246; Specified Technologies Inc. CID Cast-In Device.
  - 4. Insulated Pipes:
    - a. 2 and 3 Hour Construction: UL System F-A-5043; HoldRite HydroFlame HFP-Px, or HFP-PxB Cast-In Device.
    - b. 2 Hour Construction: UL System F-A-5041; Specified Technologies Inc. CID Cast-In Device.
    - c. 2 Hour Construction: UL System F-A-5045; Specified Technologies Inc. CID Cast-In Device.
- D. Penetrations Through Walls By:
  - 1. Uninsulated Metallic Pipe, Conduit, and Tubing:
    - a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.

- b. 1 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 2. Insulated Pipes:
  - a. 2 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - b. 2 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - c. 2 Hour Construction: UL System C-AJ-5407; HoldRite HydroFlame 200 Intumescent Firestop Sealant.
  - d. 1 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - e. 1 Hour Construction: UL System C-AJ-5091; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- 3. HVAC Ducts, Uninsulated:
  - a. 2 Hour Construction: UL System W-J-7092; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
  - b. 2 Hour Construction: UL System W-J-7109; Hilti FS-ONE MAX Intumescent Firestop Sealant, or CP 606 Flexible Firestop Sealant.
- 4. HVAC Ducts, Insulated:
  - a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

## 2.8 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:
  - 1. 2 Hour Construction: UL System W-L-0020; Specified Technologies Inc. Composite Sheet.
  - 2. 2 Hour Construction: UL System W-L-0032; Specified Technologies Inc. FP Intumescent Firestop Plug.
  - 3. 2 Hour Construction: UL System W-L-0038; Specified Technologies Inc. FP Intumescent Firestop Plug.
  - 4. 2 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
  - 5. 1 Hour Construction: UL System W-L-0020; Specified Technologies Inc. Composite Sheet.
  - 6. 1 Hour Construction: UL System W-L-0032; Specified Technologies Inc. FP Intumescent Firestop Plug.
  - 7. 1 Hour Construction: UL System W-L-0038; Specified Technologies Inc. FP Intumescent Firestop Plug.
  - 8. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.
- B. Penetrations By:
  - 1. Multiple Penetrations in Large Openings:
    - a. 2 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - b. 2 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
    - c. 2 Hour Construction: UL System W-L-8025; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
    - d. 2 Hour Construction: UL System W-L-8050; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
    - e. 2 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
    - f. 2 Hour Construction: UL System W-L-8073; Specified Technologies Inc. Composite Sheet.
    - g. 2 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.

- h. 1 and 2 Hour Construction: UL System W-L-1568; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
  - i. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - j. 1 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
  - k. 1 Hour Construction: UL System W-L-8025; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
  - l. 1 Hour Construction: UL System W-L-8050; Specified Technologies Inc. SSB Intumescent Firestop pillows.
  - m. 1 Hour Construction: UL System W-L-8071; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - n. 1 Hour Construction: UL System W-L-8073; Specified Technologies Inc. Composite Sheet.
  - o. 1 Hour Construction: UL System W-L-8079; Hilti FS-ONE MAX Intumescent Firestop Sealant.
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
- a. 2 Hour Construction: UL System W-L-1033; Specified Technologies Inc. SIL Silicone Sealant.
  - b. 2 Hour Construction: UL System W-L-1042; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
  - c. 2 Hour Construction: UL System W-L-1049; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
  - d. 2 Hour Construction: UL System W-L-1090; Specified Technologies Inc. LC Endothermic Firestop Sealant.
  - e. 2 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - f. 2 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - g. 2 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
  - h. 2 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.
  - i. 2 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
  - j. 1 and 2 Hour Construction: UL System W-L-1558; HoldRite HydroFlame 100 Intumescent Firestop Sealant.
  - k. 1 and 2 Hour Construction: UL System W-L-1558; HoldRite HydroFlame 200 Intumescent Firestop Sealant.
  - l. 1 Hour Construction: UL System W-L-1042; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
  - m. 1 Hour Construction: UL System W-L-1049; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
  - n. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - o. 1 Hour Construction: UL System W-L-1090; Specified Technologies Inc. LC Endothermic Firestop Sealant.
  - p. 1 Hour Construction: UL System W-L-1164; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - q. 1 Hour Construction: UL System W-L-1222; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
  - r. 1 Hour Construction: UL System W-L-1477; Specified Technologies Inc. EZ Firestop Grommet.
  - s. 1 Hour Construction: UL System W-L-1506; Hilti CFS-D Firestop Cable Disc.
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:

- a. 2 Hour Construction: UL System W-L-2048; Specified Technologies Inc. SSW Wrap Strips.
  - b. 2 Hour Construction: UL System W-L-2074; Specified Technologies Inc. SSC Collars.
  - c. 2 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
  - d. 2 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - e. 2 Hour Construction: UL System W-L-2237; Specified Technologies Inc. LCC Intumescent Firestop Collars.
  - f. 2 Hour Construction: UL System W-L-2241; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
  - g. 2 Hour Construction: UL System W-L-2243; Specified Technologies Inc. SSW Wrap Strips.
  - h. 2 Hour Construction: UL System W-L-2493; Specified Technologies Inc. RTC Range-Taking Collar.
  - i. 1 and 2 Hour Construction: UL System W-L-2710; HoldRite HydroFlame 200 Intumescent Firestop Sealant.
  - j. 1 Hour Construction: UL System W-L-2048; Specified Technologies Inc. SSW Wrap Strips.
  - k. 1 Hour Construction: UL System W-L-2074; Specified Technologies Inc. SSC Collars.
  - l. 1 Hour Construction: UL System W-L-2078; Hilti CP 643N/644 Firestop Collar.
  - m. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - n. 1 Hour Construction: UL System W-L-2237; Specified Technologies Inc. LCC Intumescent Firestop Collars.
  - o. 1 Hour Construction: UL System W-L-2241; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
  - p. 1 Hour Construction: UL System W-L-2243; Specified Technologies Inc. SSW Wrap Strips.
  - q. 1 Hour Construction: UL System W-L-2493; Specified Technologies Inc. RTC Range-Taking Collar.
4. Cable Trays with Electrical Cables:
- a. 2 Hour Construction: UL System W-L-4008; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
  - b. 2 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
  - c. 2 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - d. 1 Hour Construction: UL System W-L-4008; Specified Technologies Inc. SSB Intumescent Firestop Pillows.
  - e. 1 Hour Construction: UL System W-L-4011; Hilti CFS-BL Firestop Block.
  - f. 1 Hour Construction: UL System W-L-4060; Hilti FS-ONE MAX Intumescent Firestop Sealant.
5. Insulated Pipes:
- a. 2 Hour Construction: UL System W-L-5014; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
  - b. 2 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - c. 2 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
  - d. 2 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
  - e. 2 Hour Construction: UL System W-L-5273; Specified Technologies Inc. LC Endothermic Firestop Sealant.

- f. 1 Hour Construction: UL System W-L-5014; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
  - g. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - h. 1 Hour Construction: UL System W-L-5029; Hilti FS-ONE Intumescent Firestop Sealant.
  - i. 1 Hour Construction: UL System W-L-5121; Specified Technologies Inc. LCI Intumescent Firestop Sealant.
  - j. 1 Hour Construction: UL System W-L-5273; Specified Technologies Inc. LC Endothermic Firestop Sealant.
  - k. 1 Hour Construction: UL System W-L-5298; Specified Technologies Inc. WF300 Intumescent Firestop Caulk (For Wood Frame Construction).
  - l. 1 and 2 Hour Construction: UL System W-L-5357; HoldRite HydroFlame 200 Intumescent Firestop Sealant.
6. HVAC Ducts, Insulated:
- a. 2 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.
  - b. 2 Hour Construction: UL System W-L-7164; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
  - c. 2 Hour Construction: UL System W-L-7238; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
  - d. 1 Hour Construction: UL System W-L-7164; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
  - e. 1 Hour Construction: UL System W-L-7238; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
  - f. 1 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

## 2.9 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
  - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

### 3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

### 3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.
  - 1. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.



- a. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

### **3.4 FIELD QUALITY CONTROL**

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

### **3.5 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

### **3.6 PROTECTION**

- A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION**



## SECTION 07 92 00 - JOINT SEALANTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

#### 1.2 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
- B. ASTM C834 - Standard Specification for Latex Sealants.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- F. SCAQMD 1168 - Adhesive and Sealant Applications.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- C. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- D. Installation Plan: Submit at least four weeks prior to start of installation.
- E. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- F. Installation Log: Submit filled-out log for each length or instance of sealant installed.
- G. Executed warranty.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience and approved by manufacturer.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
  - 1. Adhesion Testing: In accordance with ASTM C794.
  - 2. Compatibility Testing: In accordance with ASTM C1087.
  - 3. Allow sufficient time for testing to avoid delaying the work.
  - 4. Deliver sufficient samples to manufacturer for testing.
  - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
- D. Installation Plan: Include schedule of sealed joints, including the following:
  - 1. Installation Log Form: Include the following data fields, with known information filled out.
    - a. Location on project.
    - b. Substrates.
    - c. Sealant used.
    - d. Date of installation.

- e. Name of installer.
- f. Actual joint width; provide space to indicate maximum and minimum width.
- g. Actual joint depth to face of backing material at centerline of joint.
- h. Air temperature.

## 1.5 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Nonsag Sealants:
  - 1. Bostik Inc: [www.bostik-us.com/#sle](http://www.bostik-us.com/#sle).
  - 2. Dow: [www.dow.com/#sle](http://www.dow.com/#sle).
  - 3. Pecora Corporation: [www.pecora.com/#sle](http://www.pecora.com/#sle).
  - 4. Sika Corporation: [www.usa.sika.com/#sle](http://www.usa.sika.com/#sle).
  - 5. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).

### 2.2 JOINT SEALANT APPLICATIONS

- A. Scope:
  - 1. Exterior Joints:
    - a. Seal the following joints:
      - 1) Wall expansion and control joints.
      - 2) Joints between doors, windows, and other frames or adjacent construction.
  - 2. Interior Joints:
    - a. Seal the following joints:
      - 1) Joints between door frames and window frames and adjacent construction.
      - 2) In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.
- B. Exterior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
  - 1. Lap Joints between Manufactured Metal Panels: Butyl rubber, noncuring.
- C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
  - 1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
  - 2. Wall and Ceiling Joints in Wet Areas: Nonsag polyurethane sealant for continuous liquid immersion.
  - 3. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
- D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

### 2.3 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

### 2.4 NONSAG JOINT SEALANTS

- A. Type 3 - Nonstaining Silicone Sealant: ASTM C920, Grade NS, Class 100/50, Use T
  - 1. Color: To be selected by Architect from manufacturer's standard range. Verify match in field.
  - 2. Service Temperature Range: Minus 20 to 180 degrees F.
  - 3. Products:

- a. Dow; DOWSIL 790 Silicone Building Sealant: [www.dow.com/#sle](http://www.dow.com/#sle).
  - b. Pecora Corporation; Pecora 890 NST (Non-Staining Technology):  
[www.pecora.com/#sle](http://www.pecora.com/#sle).
  - c. Sika Corporation; Sikasil WS-290: [www.usa.sika.com/#sle](http://www.usa.sika.com/#sle).
  - d. Tremco Commercial Sealants & Waterproofing; Spectrem 1:  
[www.tremcosealants.com/#sle](http://www.tremcosealants.com/#sle).
- B. Type 1 - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
  2. Color: Match adjacent finished surfaces.
  3. Service Temperature Range: Minus 40 to 180 degrees F.
  4. Products:
    - a. Sika Corporation; Sikaflex-2c NS: [www.usa.sika.com/#sle](http://www.usa.sika.com/#sle).
- C. Type OP - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.

## 2.5 ACCESSORIES

- A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.

### 3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

### 3.3 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

### 3.4 FIELD QUALITY CONTROL

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.



- B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

**END OF SECTION**

## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.
- F. Accessories, including glazing, louvers, and matching panels.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 91 23 - Interior Painting: Field painting.

#### 1.3 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. ASCE: American Society of Civil Engineers.
- C. HMMA: Hollow Metal Manufacturers Association.
- D. NAAMM: National Association of Architectural Metal Manufacturers.
- E. NFPA: National Fire Protection Association.
- F. SCIF: Sensitive Compartmented Information Facility.
- G. SDI: Steel Door Institute.
- H. UL: Underwriters Laboratories.

#### 1.4 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100).
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
- J. ASTM C476 - Standard Specification for Grout for Masonry.
- K. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.

- L. ICC A117.1 - Accessible and Usable Buildings and Facilities.
- M. ITS (DIR) - Directory of Listed Products.
- N. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames.
- O. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames.
- P. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames.
- Q. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.
- R. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- S. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
- T. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames.
- U. UL (DIR) - Online Certifications Directory.
- V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

### **1.5 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Reports for Fire-Door and Egress Door Inspections meet the requirements per Testing below.

### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: <https://steeldoor.org/sdi-certified/#sle>.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.
- D. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the Door and Hardware Institute Fire and Egress Door assembly Inspector (FDAI) certification.
- E. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the Door and Hardware Institute Fire and Egress Door assembly Inspector (FDAI) certification.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Hollow Metal Doors and Frames:



1. Ceco Door, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
2. Curries, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
3. Pioneer Industries, an Assa Abloy Group company: [www.assaabloydss.com/#sle](http://www.assaabloydss.com/#sle).
4. Republic Doors, an Allegion brand: [www.republicdoor.com/#sle](http://www.republicdoor.com/#sle).
5. Steelcraft, an Allegion brand: [www.allegion.com/#sle](http://www.allegion.com/#sle).

## 2.2 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
  2. Accessibility: Comply with ICC A117.1 and ADA Standards.
  3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
  4. Door Edge Profile: Beveled, both sides.
  5. Typical Door Face Sheets: Flush.
  6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Flush.
  7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
  8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    - a. Based on SDI Standards: Provide at least A40/ZF120 (galvanized) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvanized) for exterior and corrosive locations.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.
- D. Thermally Rated Door and Frame Assemblies: Provide exterior door & frame assemblies with U-factor of not more than 0.50 deg Btu/F x h X sq. ft. when tested according to ASTM C518.

## 2.3 HOLLOW METAL DOORS

- A. Door Finish: .
- B. Type as indicated in the Door and Frame Schedule , Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 4 - Maximum-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 2 - Seamless.
    - d. Door Face Metal Thickness: 14 gauge, 0.067 inch, minimum.
    - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
  2. Door Core Material: Manufacturer's standard core material/construction and in compliance with requirements.
  3. Door Thickness: 1-3/4 inches, nominal.
  4. Door Finish: Factory primed and field finished.
- C. Type As indicated in the Door and Frame Schedule , Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

- a. Level 3 - Extra Heavy-duty.
  - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
  - c. Model 1 - Full Flush.
  - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
  - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M for interior corrosive environments.
2. Door Thickness: 1-3/4 inches, nominal.
  3. Door Finish: Factory primed and field finished.
- D. Type as indicated in the Door and Frame Schedule , Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 3 - Extra Heavy-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
    - e. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M for corrosive environments.
  2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
  3. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
  4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
    - a. Attach fire rating label to each fire rated unit.
  5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
  6. Door Thickness: 1-3/4 inches, nominal.
  7. Door Finish: Factory primed and field finished.

## 2.4 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished, unless otherwise noted.
- C. Exterior Door Frames: Face welded type.
  1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvanized) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
  2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
  3. Frame Finish: Factory primed and field finished.
  4. Weatherstripping: Separate, see Section 08 71 00.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 90 degree angle.
  2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
  3. Frame Finish: Factory primed and field finished.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
  1. Fire Rating: Same as door, labeled.
  2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 90 degree angle.
  3. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
  4. Frame Finish: Factory primed and field finished.

- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
- H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- I. Transom Bars: Fixed, of profile same as jamb and head.
- J. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- K. Frames in Masonry Walls: Size to suit masonry coursing with head member 2 inches high to fill opening without cutting masonry units.
- L. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

## 2.5 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
  - 1. Fire-Rated Frames: Comply with fire rating requirements indicated.

## 2.6 ACCESSORIES

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components ; factory-installed. Comply with SDI 111, with blades or baffles formed of 0.20-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
  - 1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
  - 2. Style: Standard straight slat blade.
  - 3. Fasteners: Exposed or concealed fasteners.
  - 4. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
- B. Door Window Frames: Door window frames with glazing securely fastened within door opening.
  - 1. Size: As indicated on drawings.
  - 2. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
  - 3. Metal Finish: Gray polyester powder coating.
- C. Glazing: As specified in Section 08 80 00, factory installed.
- D. Removable Stops: Formed sheet steel, shape as indicated on drawings, butted corners; prepared for countersink style tamper proof screws.
- E. Astragals for Double Doors: Specified in Section 08 71 00.
- F. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- G. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- H. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- I. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

### **3.2 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

### **3.3 INSTALLATION**

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 08 71 00.
  - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- F. Comply with glazing installation requirements of Section 08 80 00.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

### **3.4 TOLERANCES**

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

### **3.5 ADJUSTING**

- A. Adjust for smooth and balanced door movement.

### **3.6 INSPECTIONS**

- A. Engage a qualified inspector to conduct inspections and provide reports to the architect.
- B. Fire-rated door inspections
  - 1. Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
- C. Egress door assemblies
  - 1. Inspect each door equipped with panic hardware, fire exit hardware, located in an exit enclosure, electrically controlled egress door, or with special locking arrangements according to NFPA 101, Section 7.2.1.15.
- D. Compliance
  - 1. Repair, remove, or replace installations that do not meet specified requirements as indicated by inspections.
- E. Re-inspection
  - 1. Reinspect repaired or replaced installations to determine that assembly installations comply with the specified requirements.
- F. Inspection Reports
  - 1. Prepare and submit a separate report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.



### 3.7 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

**END OF SECTION**



## SECTION 08 14 16 - FLUSH WOOD DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, and special function.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

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

#### 1.4 REFERENCE STANDARDS

- A. Refer to Indiana Building Code (IBC) 2012 for the effective date and sections of the referenced codes listed below.
- B. ANSI A208.1 - American National Standard for Particleboard.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.
- E. ITS (DIR) - Directory of Listed Products.
- F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- G. UL (DIR) - Online Certifications Directory.
- H. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.
- I. WDMA I.S. 1A - Interior Architectural Wood Flush Doors.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, door edge construction, factory machining, factory finishing, cutouts for glazing and other details.
- D. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
- E. Details of frame for each frame type, including dimensions and profile.
- F. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
- G. Dimensions and locations of blocking for hardware attachment.
- H. Dimensions and locations of mortises and holes for hardware.
- I. Samples:
  - 1. Submit two samples of door veneer, 8 by 10 inches in size illustrating wood grain, stain color, and sheen.
- J. Manufacturer's Installation Instructions: Indicate special installation instructions.
- K. Manufacturer's qualification statement.
- L. Installer's qualification statement.

- M. Qualification Data: For door inspector.
  - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
  - 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
  - 3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.
  - 4. Field quality-control reports.
- N. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.
- O. Specimen warranty.
- P. Warranty, executed in Owner's name.

## 1.6 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
  - 1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- D. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.
- E. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
  - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

## 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
  - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
- C. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective door and frame.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Wood Veneer Faced Doors:
  - 1. Masonite Architectural; Aspiro Select Wood Veneer Doors:  
[www.architectural.masonite.com/#sle](http://www.architectural.masonite.com/#sle).



2. VT Industries, Inc; Product 5502: [www.vtindustries.com/#sle](http://www.vtindustries.com/#sle).
3. Oshkosh Architectural Door company; Product GP: [www.oshkoshdoor.com..](http://www.oshkoshdoor.com..)

## 2.2 DOORS

- A. Doors: See drawings for locations and additional requirements.
  1. Quality Standard: Custom Grade, Extra Heavy Duty performance, in accordance with WDMA I.S. 1A.
  2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
  1. Provide solid core doors at each location.
  2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL), Intertek/Warnock Hersey (WHI), or NFPA 80; listed and labeled for required ratings based on testing at positive pressure NFPA 252 labeled without any visible seals when door is open.
  3. Wood veneer facing for field transparent finish as indicated on drawings.

## 2.3 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

## 2.4 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
  1. Vertical Edges: Same species as face veneer.
  2. "Running Match" each pair of doors and doors in close proximity to each other.
  3. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

## 2.5 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
  1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
  2. Provide solid blocking for other throughbolted hardware.
  3. Provide 5 inch top-rail blocking in doors indicated to have closers.
  4. Provide 5 inch mid-rail blocking, in doors indicated to have exit devices.
  5. Provide 5 inch bottom rail blocking, in Doors indicated to have a kick, mop, or armor plates.
- C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
- D. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- E. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions. Locate hardware to comply with DHI-WD HS-3.
- F. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
- G. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

- H. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- I. Provide edge clearances in accordance with the quality standard specified.

## 2.6 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMA/WI (AWS) or AWMA/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
  - 1. Transparent:
    - a. System - 11, Polyurethane, Catalyzed.
    - b. Stain: As selected by Architect.
    - c. Sheen: Semigloss.
  - B. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
    - 1. Transparent:
      - a. System - TR-8, UV Cured Acrylated Polyester/Urethane.
      - b. Stain: As selected by Architect.
      - c. Sheen: Semigloss.
  - C. Factory finish doors in accordance with approved sample.
  - D. Seal door top and bottom edge with color sealer to match door facing.

## 2.7 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 11 13.
- B. Door Window Frames: Door window frames with glazing securely fastened within door opening.
  - 1. Size: As indicated on drawings.
  - 2. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
  - 3. Metal Finish: Beige polyester powder coating.
- C. Glazing: See Section 08 80 00.
- D. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- E. Door Hardware: See Section 08 71 00.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### 3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Field-Finished Doors: Trimming to fit is acceptable.
  - 1. Adjust width of non-rated doors by cutting equally on both jamb edges.
  - 2. Trim maximum of 3/4 inch off bottom edges.
  - 3. Trim fire-rated doors in strict compliance with fire rating limitations.
  - 4. Restore finish before installation.
- D. Use machine tools to cut or drill for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.

- F. Coordinate installation of glazing.
- G. Install door louvers plumb and level.

### **3.3 TOLERANCES**

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  - 1. Provide inspection of installed Work through specified standard for the specified grade.
  - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
  - 3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

### **3.5 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.
- C. Adjust doors to hang free from rattling when in latched position.
- D. Operation: Rehang or replace doors that do not swing or operate freely.
- E. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

**END OF SECTION**



## SECTION 08 33 13 - COILING COUNTER DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Non-fire-rated coiling counter doors and operating hardware.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Rough openings.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 08 71 00 - Door Hardware: Cylinder cores and keys.
- D. Section 09 21 16 - Gypsum Board Assemblies: Rough openings.

#### 1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.
- C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Specimen warranty.
- H. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years documented experience.

#### 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for counterbalance shaft assembly. Complete forms in Owner's name and register with manufacturer.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Coiling Counter Doors:
  - 1. Alpine Overhead Doors, Inc; Counter Shutter - Rolling Shutters: [www.alpinedoors.com/#sle](http://www.alpinedoors.com/#sle).
  - 2. ASTA America by Janus International; 700 Series Counter Shutter: [www.astaamerica.com/#sle](http://www.astaamerica.com/#sle).
  - 3. C.H.I. Overhead Doors; Model 6522 (steel): [www.chiohd.com/#sle](http://www.chiohd.com/#sle).
  - 4. Overhead Door Corporation; Counter Door - Model 650: [www.overheaddoor.com/#sle](http://www.overheaddoor.com/#sle).

5. Wayne-Dalton, a Division of Overhead Door Corporation; Security Shutter - Model 523:  
[www.wayne-dalton.com/#sle](http://www.wayne-dalton.com/#sle).

## 2.2 COILING COUNTER DOORS

- A. Coiling Counter Metal Doors, Non-Fire-Rated: Aluminum slat curtain.
  1. Mounting: Between jambs, within prepared opening.
  2. Provide integral frame and sill of same material and finish.
  3. Nominal Slat Size: 1-1/4 inches wide.
  4. Slat Profile: Flat, perforated.
  5. Finish, Stainless Steel: No. 4 - Brushed.
  6. Color: As selected by Architect from manufacturer's standard range.
  7. Guides: Formed track; same material and finish unless otherwise indicated.
  8. Hood Enclosure: Manufacturer's standard; primed steel.
  9. Manual hand chain lift operation.
  10. Locking Devices: Lock and latch handle on outside.

## 2.3 COMPONENTS

- A. Metal Curtain Construction: Interlocking, single-thickness slats.
  1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
  2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
  3. Aluminum Slats: ASTM B221 (ASTM B221M), aluminum alloy Type 6063; minimum thickness 0.05 inch.
- B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
  1. Aluminum Guides: Extruded aluminum channel, with wool pile runners along inside.
- C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
- D. Lock Hardware:
  1. Cylindrical Locking Mechanism: Latchset lock cylinder, specified in Section 08 71 00.
  2. Latchset Lock Cylinders: Standard mortise cylinder type; keyed differently.
    - a. Keying: Differently.
  3. Latch Handle: Manufacturer's standard.
- E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that adjacent construction is suitable for door installation.
- B. Verify that electrical services have been installed and are accessible.
- C. Verify that door opening is plumb, header is level, and dimensions are correct.
- D. Notify Architect of any unacceptable conditions or varying dimensions.
- E. Commencement of installation indicates acceptance of substrate and door opening conditions.

### 3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.



D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

**3.3 ADJUSTING**

A. Adjust operating assemblies for smooth and noiseless operation.

**3.4 CLEANING**

A. Clean installed components.

B. Remove labels and visible markings.

**END OF SECTION**





## SECTION 08 43 13 - ALUMINUM-FRAMED STOREFRONTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of metal and glass.
- C. Aluminum doors and frames.
- D. Weatherstripping.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Steel attachment members.
- B. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 08 44 13 - Glazed Aluminum Curtain Walls.
- D. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- E. Section 08 80 00 - Glazing: Glass and glazing accessories.

#### 1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- F. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- G. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- G. Manufacturer's qualification statement.

- H. Installer's qualification statement.
- I. Specimen warranty.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

## 1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

## 1.9 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide ten year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Aluminum-Framed Storefronts:
  - 1. Cross Aluminum Products
  - 2. EFCO Corporation
  - 3. Kawneer North America: [www.kawneer.com/#sle](http://www.kawneer.com/#sle).
  - 4. Oldcastle BuildingEnvelope: [www.oldcastlebe.com/#sle](http://www.oldcastlebe.com/#sle).
  - 5. Special-Lite
  - 6. Tubelite, Inc: [www.tubeliteinc.com/#sle](http://www.tubeliteinc.com/#sle).
  - 7. Wausau Window and Wall Systems
  - 8. YKK AP America, Inc: [www.ykkap.com/commercial/#sle](http://www.ykkap.com/commercial/#sle).

### 2.2 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
  - 1. Glazing Rabbet: For 1 inch insulating glazing.
  - 2. Glazing Position: Centered (front to back).
  - 3. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
  - 4. Finish: Superior performing organic coatings.
    - a. Factory finish all surfaces that will be exposed in completed assemblies.
    - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
  - 5. Finish Color: As selected by Architect from manufacturer's standard line.
  - 6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
  - 7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.

8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
  10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
  11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
  12. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
- B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
    - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
  2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.

## 2.3 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.

## 2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Structural Supporting Anchors: See Section 05 12 00.
- D. Fasteners: Stainless steel.
- E. Sealant for Setting Thresholds: Non-curing butyl type.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- G. Glazing Accessories: See Section 08 80 00.

## 2.5 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: See Section 08 71 00.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in bed of sealant and secure.
- J. Install hardware using templates provided.
  - 1. See Section 08 71 00 for hardware installation requirements.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### **3.2 TOLERANCES**

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

### **3.3 FIELD QUALITY CONTROL**

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 40 00 - Quality Requirements for general testing and inspection requirements.
- C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
  - 1. Perform a minimum of two tests in each designated area as indicated on drawings.
  - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
- D. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

### **3.4 ADJUSTING**

- A. Adjust operating hardware and sash for smooth operation.

### **3.5 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

### **3.6 PROTECTION**

- A. Protect installed products from damage until Date of Substantial Completion.

**END OF SECTION**

## SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Aluminum-framed curtain wall, with vision glazing and infill panels.
- B. Aluminum-framed sloped curtain wall with vision glazing.
- C. Associated louvers and operable sashes.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Weld plates embedded in concrete for attachment of anchors.
- B. Section 05 12 00 - Structural Steel Framing: Steel attachment members.
- C. Section 07 84 00 - Firestopping: Firestop at system junction with structure.
- D. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- E. Section 08 43 13 - Aluminum-Framed Storefronts: Entrance framing and doors.
- F. Section 08 80 00 - Glazing.
- G. Section 09 21 16 - Gypsum Board Assemblies: Metal stud and gypsum board wall at interior of curtain wall.
- H. Section 09 91 23 - Interior Painting: Field painting of interior surface of infill panels.

#### 1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
- B. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift.
- C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document).
- D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
- E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- F. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- G. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- H. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- I. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

- N. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with installation of other components that comprise the exterior enclosure.

#### **1.5 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Samples: Submit two samples illustrating finished aluminum surface, glazing, glazing materials, and gasketing.
- E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
- F. Structural Sealant Glazing (SSG): Submit product data and calculations showing compliance with performance requirements.
- G. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
- H. Installer's Qualification Statement.
- I. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### **1.6 QUALITY ASSURANCE**

- A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

#### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

#### **1.8 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 10-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with installer.
- C. Finish Warranty: Provide 10-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Glazed Aluminum Curtain Walls Manufacturers:
1. EFCO Corporation
  2. Kawneer North America.
  3. Oldcastle Building Envelope.
  4. Tubelite, Inc.
  5. YKK AP America, Inc.

### 2.2 BASIS OF DESIGN - CURTAIN WALL SYSTEMS

- A. Four (4)-Sided Structural Sealant Glazing (SSG):
1. Basis of Design: Kawneer North America, an Arconic Company; 1600 Wall System, Thermally Broken.
  2. Basis of Design: EFCO Corporation; **Thermally Broken** from the System 5600 series.
  3. Basis of Design: Oldcastle BuildingEnvelope; **Thermally Broken** from Reliance Curtainwall Series.
  4. Basis of Design: Tubelite Inc.; **Thermally Broken** from the 400TU Series.
  5. Basis of Design: YKK AP America Inc.; **Thermally Broken** from the YCW 750 OG Series.
- B. Pressure Cap Four Sides; Not Unitized, Field Assembled:
1. Basis of Design: Kawneer North America, an Arconic Company; 1600 Wall System, Thermally Broken.
  2. Basis of Design: EFCO Corporation; **Thermally Broken** from the System 5600 series.
  3. Basis of Design: Oldcastle BuildingEnvelope; **Thermally Broken** from Reliance Curtainwall Series.
  4. Basis of Design: Tubelite Inc.; **Thermally Broken** from the 400T Series.
  5. Basis of Design: YKK AP America Inc.; **Thermally Broken** from the YCW 750 OG Series.
- C. Pressure Cap at Horizontals with Two (2)-Sided Structural Sealant Glazing (SSG) at Verticals:
1. Basis of Design: Kawneer North America, an Arconic Company; 1600 Wall System, Thermally Broken.
  2. Basis of Design: EFCO Corporation; **Thermally Broken** from the System 5600 series.
  3. Basis of Design: Oldcastle BuildingEnvelope; **Thermally Broken** from Reliance Curtainwall Series.
  4. Basis of Design: Tubelite Inc.; **Thermally Broken** from the 400T Series.
  5. Basis of Design: YKK AP America Inc.; **Thermally Broken** from the YCW 750 OG Series.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

### 2.3 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Outside glazed, with pressure plate and mullion cover, where indicated on drawings.
  2. Structural sealant glazing (SSG) adhesive on four (4)-sides, with temporary glazing stops, where indicated on drawings.
  3. Glazing Method: Shop/factory glazed system.
  4. Vertical Mullion Face Width: 2-1/2 inches.
  5. Vertical Mullion Depth From Face of Glazing to Back of Frame: 6 inches and 6-1/4 inches.
  6. Finish: Class I natural anodized.
    - a. Factory finish surfaces that will be exposed in completed assemblies.
    - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

- c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
  7. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
  8. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
  9. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  10. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
  11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
  1. Design Wind Loads: Comply with Code - Building or structural drawings, whichever is greater.
    - a. Measure performance by testing in accordance with ASTM E330/E330M, using test loads equal to 1.5 times the design wind loads and 10 second duration of maximum pressure.
    - b. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
    - c. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
  2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
  3. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
  4. Movement: Accommodate the following movement without damage to components or deterioration of seals:
    - a. Expansion and contraction caused by 180 degrees F surface temperature.
    - b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
    - c. Movement of curtain wall relative to perimeter framing.
    - d. Deflection of structural support framing, under permanent and dynamic loads.
  5. Structural Sealant Glazing (SSG) System: For individual glass lites, design framing members to not exceed a deflection normal to the wall of L/175 between supports with 3/4 inch maximum, and a deflection parallel to the wall of L/360 with 1/8 inch maximum, whichever is less.
- C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
  1. Test Pressure Differential: 10 psf.
  2. Test Method: ASTM E331.
- D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.24 psf pressure difference across assembly.
- E. Thermal Performance Requirements:



1. Condensation Resistance Factor of Framing: 55, minimum, measured in accordance with AAMA 1503.
2. Overall U-value Including Glazing: U-0.42 Btu/(hr sq ft deg F), maximum.

## 2.4 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  1. Framing members for interior applications need not be thermally broken.
- B. Glazing: See Section 08 80 00.
- C. Venting Windows:
  1. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
    - a. Outswinging Casement Type:
      - 1) Construction: Thermally broken.
      - 2) Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, as follows:
        - (a) Aluminum Wire Fabric: 18-by-18 mesh of 0.013-inch-diameter, coated aluminum wire.
      - 3) Exterior Finish: Match curtain wall system.
      - 4) Interior Finish: Match curtain wall system.
    2. Hardware:
      - a. Sash lock: Lever handle with cam lock.
      - b. Operator: Lever action handle fitted to projecting sash arms with limit stops.
      - c. Window Opening Control Devices (WOCD): Provide operable window sash hardware that limits openings to only allow passage of 4 inch diameter rigid sphere or less, and are easily releasable to fully open without use of keys, tools, or special knowledge.
      - d. Pulls: Manufacturer's standard type.
      - e. Limit Stops: Resilient rubber.
    3. Glazing: See Section 08 80 00.
    4. Rescue/Egress Provisions and Egress Hardware
      - a. Make provisions for egress in case of emergency at windows as indicated on drawings.
      - b. Affix permanent aluminum tags or vinyl stickers to each rescue window. Lettering to be not less than 5/8 inch high and 1/8 inch wide and read "Rescue Window".
      - c. Rescue/Egress windows to meet NFPA 101, Michigan State Fire Safety Board amendments to NFPA 101 (New and Existing School, College, and University Fire Safety Rules and Code - Building for emergency size and operation.
    5. Insect Screens: Extruded aluminum frame with mitered and reinforced corners; screen mesh taut and secure to frame; secured to window with adjustable hardware allowing screen removal without use of tools.
    6. Operable Sash Weatherstripping: permanently resilient, profiled to achieve effective weather seal.
    7. Finish: Match curtain wall finish

## 2.5 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.
- D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.
- E. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, and compatible with flashing material.

- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- G. Glazing Accessories: See Section 08 80 00.

## **2.6 FINISHES**

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A44 Electrolytically deposited colored anodic coating not less than 0.7 mils thick.
  - 1. Color: Black and As Selected by Architect.
- C. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
- D. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other related work.
- B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

### **3.2 INSTALLATION**

- A. Install curtain wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions.
- H. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### **3.3 TOLERANCES**

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet noncumulative or 0.5 inches per 100 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

### **3.4 ADJUSTING**

- A. Adjust operating sash for smooth operation.

### **3.5 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.



- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

**END OF SECTION**



## SECTION 08 51 13 - ALUMINUM WINDOWS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Extruded aluminum windows with fixed sash, operating sash, and infill panels.
- B. Factory glazing.
- C. Operating hardware.
- D. Insect screens.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Rough opening framing.
- B. Section 06 10 00 - Rough Carpentry: Wood perimeter shims.
- C. Section 07 92 00 - Joint Sealants: Sealing joints between window frames and adjacent construction.
- D. Section 08 80 00 - Glazing.

#### 1.3 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights.
- B. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
- C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document).
- D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
- E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- F. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- G. ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Include component dimensions, information on glass and glazing, internal drainage details, and descriptions of hardware and accessories.
- C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, anchorage locations, and installation requirements.
- D. Samples:
  - 1. Framing: One samples, 12 by 12 inch in size illustrating typical corner construction, accessories, and finishes.
  - 2. Sashes: One samples, 12 by 12 inch in size illustrating typical corner construction, accessories, and finishes.
  - 3. Operating Hardware: Two samples of each type and finish.
- E. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
  - 1. Evidence of AAMA Certification.
  - 2. Evidence of WDMA Certification.
  - 3. Evidence of CSA Certification.
  - 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.

- F. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.
- G. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.
- H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- I. Installer's qualification statement.
- J. Specimen warranty.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

### **1.7 FIELD CONDITIONS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

### **1.8 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Manufacturer Warranty: Provide 10-year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units. Complete forms in Owner's name and register with manufacturer.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Aluminum Window Manufacturers:
  - 1. EFCO Corporation: <https://www.efcocorp.com/>.
  - 2. Kawneer North America, an Arconic Company / Traco: <https://www.kawneer.us/>.
  - 3. TRACO: [www.traco.com/#sle](http://www.traco.com/#sle).
  - 4. Wausau Window and Wall Systems: [www.wausauwindow.com/#sle](http://www.wausauwindow.com/#sle).

### **2.2 BASIS OF DESIGN - AW PERFORMANCE CLASS WINDOWS**

- A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 having Performance Class of AW, and Performance Grade at least as high as specified design pressure.
- B. Fixed, Thermally-Broken:
  - 1. Basis of Design: EFCO Corporation; FX45.
- C. Projected, Face of Sash and Frame in Approximately Same Plane:
  - 1. Basis of Design: EFCO Corporation; 450X.

### **2.3 ALUMINUM WINDOWS**

- A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
  - 1. Frame Depth: 3-1/2 inch.

2. Operable Units: Double weatherstripped.
  3. Provide factory-glazed units.
  4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
  5. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
  6. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
  7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  8. Thermal Movement: Design to accommodate thermal movement caused by 180 degrees F surface temperature without buckling stress on glass, joint seal failure, damaging loads on structural elements, damaging loads on fasteners, reduction in performance or other detrimental effects.
- B. Fixed, Non-Operable Type:
1. Construction: Thermally broken.
  2. Glazing: Single; clear; transparent.
  3. Exterior Finish: Class I natural anodized.
  4. Interior Finish: Class I natural anodized.
- C. Inswinging Hopper Type:
1. Construction: Thermally broken.
  2. Provide screens.
  3. Glazing: Single; clear; transparent.
  4. Exterior Finish: Class I natural anodized.
  5. Interior Finish: Class I natural anodized.

## 2.4 PERFORMANCE REQUIREMENTS

- A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
1. Performance Class (PC): R.
  2. Performance Grade (PG): 15, with minimum design pressure (DP) of 15.04 psf.
- B. Condensation Resistance Factor of Frame: 50, measured in accordance with AAMA 1503.
- C. Overall Thermal Transmittance (U-value): 0.35, maximum, including glazing, measured on window sizes required for this project.
- D. Acoustic Performance: Minimum outdoor-indoor transmission class (OITC) rating of 34, when tested in accordance with ASTM E90 and ASTM E1332.

## 2.5 HARDWARE

- A. Window Opening Control Devices (WOCD): Provide operable window sash hardware that limits openings to only allow passage of 4 inch diameter rigid sphere or less, and are easily releasable to fully open without use of keys, tools, or special knowledge.
- B. Limit Stops: Resilient rubber.

## 2.6 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41, clear anodic coating not less than 0.7 mil thick.
- B. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42, integrally colored anodic coating not less than 0.7 mil thick.
- C. Finish Color: As selected by Architect from manufacturer's standard range.
- D. Operator and Exposed Hardware: Enameled to color as selected from manufacturer's standard line.

- E. Apply one coat of bituminous coating to concealed aluminum and steel surfaces in contact with dissimilar materials.
- F. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that wall openings and adjoining water-resistive barrier materials are ready to receive aluminum windows; see Section 07 25 00.

#### **3.2 PRIME WINDOW INSTALLATION**

- A. Install windows in accordance with manufacturer's instructions.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- D. Install sill and sill end angles.
- E. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- F. Install operating hardware not pre-installed by manufacturer.
- G. Install glass and infill panels in accordance with requirements; see Section 08 80 00.

#### **3.3 ADJUSTING**

- A. Adjust hardware for smooth operation and secure weathertight closure.

#### **3.4 CLEANING**

- A. Remove protective material from factory finished aluminum surfaces.
- B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

**END OF SECTION**



## SECTION 08 71 00 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Mechanical and electrified door hardware
  - 2. Electronic access control system components
- B. Section excludes:
  - 1. Windows
  - 2. Cabinets (casework), including locks in cabinets
  - 3. Signage
  - 4. Toilet accessories
  - 5. Overhead doors
- C. Related Sections:
  - 1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
  - 2. Division 06 Section "Rough Carpentry"
  - 3. Division 06 Section "Finish Carpentry"
  - 4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
  - 5. Division 08 Sections:
    - a. "Metal Doors and Frames"
    - b. "Flush Wood Doors"
    - c. "Stile and Rail Wood Doors"
    - d. "Interior Aluminum Doors and Frames"
    - e. "Aluminum-Framed Entrances and Storefronts"
    - f. "Stainless Steel Doors and Frames"
    - g. "Special Function Doors"
    - h. "Entrances"
  - 6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
  - 7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

#### 1.2 REFERENCES

- A. UL LLC
  - 1. UL 10B - Fire Test of Door Assemblies
  - 2. UL 10C - Positive Pressure Test of Fire Door Assemblies
  - 3. UL 1784 - Air Leakage Tests of Door Assemblies
  - 4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
  - 1. Sequence and Format for the Hardware Schedule
  - 2. Recommended Locations for Builders Hardware

3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware
- C. NFPA – National Fire Protection Association
  1. NFPA 70 – National Electric Code
  2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
  3. NFPA 101 – Life Safety Code
  4. NFPA 105 – Smoke and Draft Control Door Assemblies
  5. NFPA 252 – Fire Tests of Door Assemblies
- D. ANSI - American National Standards Institute
  1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
  2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
  3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
  4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
  5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

### 1.3 SUBMITTALS

- A. General:
  1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
  2. Prior to forwarding submittal:
    - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
    - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- B. Action Submittals:
  1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
  2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
    - a. Wiring Diagrams: For power, signal, and control wiring and including:
      - 1) Details of interface of electrified door hardware and building safety and security systems.
      - 2) Schematic diagram of systems that interface with electrified door hardware.
      - 3) Point-to-point wiring.
      - 4) Risers.
  3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
    - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
  4. Door Hardware Schedule:

- a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
  - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
  - c. Indicate complete designations of each item required for each opening, include:
    - 1) Door Index: door number, heading number, and Architect's hardware set number.
    - 2) Quantity, type, style, function, size, and finish of each hardware item.
    - 3) Name and manufacturer of each item.
    - 4) Fastenings and other pertinent information.
    - 5) Location of each hardware set cross-referenced to indications on Drawings.
    - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    - 7) Mounting locations for hardware.
    - 8) Door and frame sizes and materials.
    - 9) Degree of door swing and handing.
    - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
  - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
  - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
  - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
  - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
  - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
  2. Provide Product Data:
    - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

- a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
  - b. Catalog pages for each product.
  - c. Final approved hardware schedule edited to reflect conditions as installed.
  - d. Final keying schedule
  - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
  - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- E. Inspection and Testing:
1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
    - a. Fire door assemblies, in compliance with NFPA 80.
    - b. Required egress door assemblies, in compliance with NFPA 101.

#### 1.4 QUALITY ASSURANCE

- A. Qualifications and Responsibilities:
1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
  2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
  3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
    - a. For door hardware: DHI certified AHC or DHC.
    - b. Can provide installation and technical data to Architect and other related subcontractors.
    - c. Can inspect and verify components are in working order upon completion of installation.
    - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
  4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- B. Certifications:
1. Fire-Rated Door Openings:
    - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
    - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:
    - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
    - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
  3. Electrified Door Hardware
    - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
  4. Accessibility Requirements:
    - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.
- C. Pre-Installation Meetings
1. Keying Conference
    - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      - 2) Preliminary key system schematic diagram.
      - 3) Requirements for key control system.
      - 4) Requirements for access control.
      - 5) Address for delivery of keys.
  2. Pre-installation Conference
    - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - b. Inspect and discuss preparatory work performed by other trades.
    - c. Inspect and discuss electrical roughing-in for electrified door hardware.
    - d. Review sequence of operation for each type of electrified door hardware.
    - e. Review required testing, inspecting, and certifying procedures.
    - f. Review questions or concerns related to proper installation and adjustment of door hardware.
  3. Electrified Hardware Coordination Conference:
    - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

## 1.6 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

## 1.7 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
  - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
  - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    - a. Mechanical Warranty
      - 1) Locks
        - a) Schlage ND Series: 10 years
      - 2) Exit Devices
        - a) Falcon: 10 years
      - 3) Closers
        - a) LCN 1460 Series: 30 years
      - 4) Automatic Operators
        - a) LCN: 2 years
    - b. Electrical Warranty
      - 1) Exit Devices
        - a) Falcon: 3 years
      - 2) Closers
        - a) LCN: 2 years

## 1.8 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
  - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

### 2.2 MATERIALS

- A. Fabrication
  - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
  - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
  - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
  - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- C. Cable and Connectors:
  - 1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
  - 2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
  - 3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

### 2.3 HINGES

- A. Manufacturers and Products:
  - 1. Scheduled Manufacturer and Product:
    - a. Ives 5BB series
  - 2. Acceptable Manufacturers and Products:
    - a. Hager BB1191/1279 series

- b. McKinney TB series
- B. Requirements:
  - 1. Provide hinges conforming to ANSI/BHMA A156.1.
  - 2. Provide five knuckle, ball bearing hinges.
  - 3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
    - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
    - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
  - 4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
    - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
    - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
  - 5. 2 inches or thicker doors:
    - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
    - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
  - 6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
  - 7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
  - 8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
    - a. Steel Hinges: Steel pins
    - b. Non-Ferrous Hinges: Stainless steel pins
    - c. Out-Swinging Exterior Doors: Non-removable pins
    - d. Out-Swinging Interior Lockable Doors: Non-removable pins
    - e. Interior Non-lockable Doors: Non-rising pins
  - 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

## 2.4 CONTINUOUS HINGES

- A. Manufacturers:
  - 1. Scheduled Manufacturer:
    - a. Ives
  - 2. Acceptable Manufacturers:
    - a. Select
    - b. Hager
- B. Requirements:
  - 1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
  - 2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
  - 3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
  - 4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
  - 5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.



6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

## 2.5 ELECTRIC POWER TRANSFER

- A. Manufacturers:
  1. Scheduled Manufacturer and Product:
    - a. Von Duprin EPT-10
  2. Acceptable Manufacturers and Products:
    - a. ABH PT1000
    - b. Securitron CEPT-10
- B. Requirements:
  1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
  2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

## 2.6 FLUSH BOLTS

- A. Manufacturers:
  1. Scheduled Manufacturer:
    - a. Ives
  2. Acceptable Manufacturers:
    - a. Rockwood
    - b. Trimco
- B. Requirements:
  1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

## 2.7 COORDINATORS

- A. Manufacturers:
  1. Scheduled Manufacturer:
    - a. Ives
  2. Acceptable Manufacturers:
    - a. Trimco
    - b. Rockwood
- B. Requirements:
  1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.

2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

## 2.8 MORTISE LOCKS

- A. Manufacturers and Products:
  1. Scheduled Manufacturer and Product:
    - a. Schlage L9000 series
  2. Acceptable Manufacturers and Products:
    - a. No Substitute
- B. Requirements:
  1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
  2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
  3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
  4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
  5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
  6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
  7. Provide motor based electrified locksets that comply with the following requirements:
    - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
    - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
    - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
    - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
    - e. Connections – provide quick-connect Molex system standard.
  8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

## 2.9 CYLINDRICAL LOCKS – GRADE 1

- A. Manufacturers and Products:
  1. Scheduled Manufacturer and Product:
    - a. Schlage ND series
  2. Acceptable Manufacturers and Products:
    - a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
  - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
  - b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
  - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
  - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
  - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
  - a. Lever Design: RHO

## 2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Falcon 24/25 series
2. Acceptable Manufacturers and Products:
  - a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer's approved strikes.

8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

## 2.11 ELECTRIC STRIKES

- A. Manufacturers and Products:
  1. Scheduled Manufacturer and Product:
    - a. HES 5000 and 9600
  2. Acceptable Manufacturers:
    - a. No Substitute
- B. Requirements:
  1. Provide electric strikes designed for use with type of locks shown at each opening.
  2. Provide electric strikes UL Listed as burglary resistant.
  3. Provide electric strikes that are field selectable fail-safe and fail-secure.
  4. Provide electric strikes cycle tested to endure a minimum of 250,000 cycles.
  5. Where required, provide electric strikes UL Listed for fire doors and frames.
  6. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

## 2.12 POWER SUPPLIES

- A. Manufacturers and Products:
  1. Scheduled Manufacturer and Product:
    - a. Schlage/Von Duprin PS900 Series
  2. Acceptable Manufacturers and Products:
    - a. Precision ELR series
    - b. Securitron BPS series
- B. Requirements:
  1. Provide power supplies approved by manufacturer of supplied electrified hardware.
  2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
  3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
  4. Provide power supplies with the following features:
    - a. 12/24 VDC Output, field selectable.

- b. Class 2 Rated power limited output.
- c. Universal 120-240 VAC input.
- d. Low voltage DC, regulated and filtered.
- e. Polarized connector for distribution boards.
- f. Fused primary input.
- g. AC input and DC output monitoring circuit w/LED indicators.
- h. Cover mounted AC Input indication.
- i. Tested and certified to meet UL294.
- j. NEMA 1 enclosure.
- k. Hinged cover w/lock down screws.
- l. High voltage protective cover.

### 2.13 CYLINDERS

- A. Manufacturers:
  - 1. Scheduled Manufacturer and Product:
    - a. Best
  - 2. Acceptable Manufacturers and Products:
    - a. No Substitute
- B. Requirements:
  - 1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

### 2.14 KEYING

- A. Scheduled System:
  - 1. Existing factory registered system:
    - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Requirements:
  - 1. Construction Keying:
    - a. Replaceable Construction Cores.
      - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
        - a) 3 construction control keys
        - b) 12 construction change (day) keys.
      - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
  - 2. Permanent Keying:
    - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      - 1) Master Keying system as directed by the Owner.
    - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

- c. Provide keys with the following features:
  - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
  - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
- d. Identification:
  - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
  - 2) Identification stamping provisions must be approved by the Architect and Owner.
  - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
  - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
  - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
  - 1) Permanent Control Keys: 3.
  - 2) Master Keys: 6.
  - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
  - 4) Key Blanks: Quantity as determined in the keying meeting.

## 2.15 DOOR CLOSERS

- A. Manufacturers and Products:
  - 1. Scheduled Manufacturer and Product:
    - a. LCN 1460 series
  - 2. Acceptable Manufacturers and Products:
    - a. No Substitute
- B. Requirements:
  - 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory.
  - 2. Provide door closers with fully hydraulic, full rack and pinion action cast iron cylinder.
  - 3. Closer Body: 1-1/4-inch (32 mm) diameter, with 5/8-inch (16 mm) diameter heat-treated pinion journal.
  - 4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
  - 5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
  - 6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
  - 7. Pressure Relief Valve (PRV) Technology: Not permitted.
  - 8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

## 2.16 ELECTROMECHANICAL CLOSER/HOLDERS

- A. Manufacturers:

1. Scheduled Manufacturer:
    - a. LCN
  2. Acceptable Manufacturers:
    - a. No Substitute
- B. Requirements:
1. Provide single-point or multi-point hold-open electromechanical closer/holders as specified. Coordinate voltage requirements and provide transformer if necessary.
  2. Provide closer/holders that function as full rack and pinion door closer when current is interrupted or continuous hold-open is not engaged.
  3. Provide door closers with fully hydraulic, full rack and pinion action with high strength cylinder and full complement bearings at shaft.
  4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
  5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
  6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
  7. Pressure Relief Valve (PRV) Technology: Not permitted.
  8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

## 2.17 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

- A. Manufacturers and Products:
1. Scheduled Manufacturer and Product:
    - a. LCN 4600 series
  2. Acceptable Manufacturers and Products:
    - a. No Substitute
- B. Requirements:
1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
  2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
  3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
  4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
  5. Provide drop plates, brackets, and adapters for arms as required for details.
  6. Provide actuator switches and receivers for operation as specified.
  7. Provide weather-resistant actuators at exterior applications.
  8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
  9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each

individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

## **2.18 DOOR TRIM**

### **A. Manufacturers:**

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Trimco
  - b. Rockwood

### **B. Requirements:**

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

## **2.19 PROTECTION PLATES**

### **A. Manufacturers:**

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Trimco
  - b. Rockwood

### **B. Requirements:**

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Size plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

## **2.20 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS**

### **A. Manufacturers:**

1. Scheduled Manufacturers:
  - a. Glynn-Johnson
2. Acceptable Manufacturers:
  - a. Rixson
  - b. ABH

### **B. Requirements:**

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

## **2.21 DOOR STOPS AND HOLDERS**

### **A. Manufacturers:**

1. Scheduled Manufacturer:



- a. Ives
2. Acceptable Manufacturers:
  - a. Trimco
  - b. Rockwood
- B. Provide door stops at each door leaf:
  1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
  2. Where a wall stop cannot be used, provide universal floor stops.
  3. Where wall or floor stop cannot be used, provide overhead stop.
  4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

## **2.22 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING**

- A. Manufacturers:
  1. Scheduled Manufacturer:
    - a. Zero International
  2. Acceptable Manufacturers:
    - a. National Guard
    - b. Reese
- B. Requirements:
  1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
  2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
  3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
  4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## **2.23 SILENCERS**

- A. Manufacturers:
  1. Scheduled Manufacturer:
    - a. Ives
  2. Acceptable Manufacturers:
    - a. Rockwood
    - b. Trimco
- B. Requirements:
  1. Provide "push-in" type silencers for hollow metal or wood frames.
  2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
  3. Omit where gasketing is specified.

## **2.24 FINISHES**

- A. FINISH: BHMA 626/652 (US26D); EXCEPT:
  1. Hinges at Exterior Doors: BHMA 630 (US32D)

2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
  1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  2. Custom Steel Doors and Frames: HMMA 831.
  3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
  4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
  1. Install construction cores to secure building and areas during construction period.
  2. Replace construction cores with permanent cores as indicated in keying section.

3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
1. Conduit, junction boxes and wire pulls.
  2. Connections to and from power supplies to electrified hardware.
  3. Connections to fire/smoke alarm system and smoke evacuation system.
  4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
  5. Connections to panel interface modules, controllers, and gateways.
  6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.3 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
  2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
  3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

### 3.4 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.

- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

### **3.5 DOOR HARDWARE SCHEDULE**

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:



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Hardware Group No. 01

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	628	IVE
1	EA	CONST LATCHING BOLT	FB51P/FB61P AS REQ	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	COORDINATOR	COR X FL X MB - AS REQ.	628	IVE
2	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	OVERLAPPING ASTRAGAL	322A	A	ZER
1	SET	GASKETING	328AA-S JAMB SEAL SET	AA	ZER
1	EA	GASKETING	429AA HEAD SEAL	AA	ZER
			MOUNT PRIOR TO ANY HEAD MOUNTED HARDWARE		
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER

Hardware Group No. 02

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	1461 SCUSH STD ST-2693	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA-S JAMB SEAL SET	AA	ZER
1	EA	GASKETING	429AA HEAD SEAL	AA	ZER
			MOUNT PRIOR TO ANY HEAD MOUNTED HARDWARE		
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. SCHEDULED UNLOCKING AVAILABLE OR PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 03

Provide each SGL door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	1461 SCUSH STD ST-2693	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA-S JAMB SEAL SET	AA	ZER
1	EA	GASKETING	429AA HEAD SEAL	AA	ZER
			MOUNT PRIOR TO ANY HEAD		
			MOUNTED HARDWARE		
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER

Hardware Group No. 04

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 SCUSH STD ST-2693	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA-S JAMB SEAL SET	AA	ZER
1	EA	GASKETING	429AA HEAD SEAL	AA	ZER
			MOUNT PRIOR TO ANY HEAD		
			MOUNTED HARDWARE		
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH	LGR	SCE
			ACCESS CONTROL)		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 05

Provide each SGL door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	CLASSROOM LOCK	ND70BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 EDA STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. SCHEDULED UNLOCKING AVAILABLE OR PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 06

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 EDA STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	1461 REG OR PA AS REQ STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE



OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 08

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 REG OR PA AS REQ STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 09

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 10

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 11

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 REG OR PA AS REQ STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 12

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SURFACE CLOSER	1461 REG OR PA AS REQ STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 13

Provide each SGL door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	1461 REG OR PA AS REQ STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 14

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC STRIKE	5000 FSE	630	HES
1	EA	CONST LATCHING BOLT	FB51T/FB61T (AS REQ'D)	630	IVE
1	EA	STOREROOM LOCK	ND80BDC RHO	626	SCH
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	COORDINATOR	COR X FL X MB - AS REQ.	628	IVE
2	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 15

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY	628	IVE
2	EA	PUSH/PULL BAR	9190EZHD-8"-NS	630-316	IVE
2	EA	SURFACE CLOSER	1461 SHCUSH STD	689	LCN
2	EA	PA MOUNTING PLATE	1460-18PA SRT	689	LCN
2	EA	CUSH SHOE SUPPORT	1460-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	1460-61 SRT	689	LCN
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O

Hardware Group No. 16

Provide each SGL door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	F-25-R-L-NL-DANE	626	FAL
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
1	EA	OH STOP	100SE	630	GLY
1	EA	FIRE/LIFE CLOSER	4040SE 24V/120V AC/DC AS REQ PUSH SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM FIRE ALARM. FREE EGRESS AT ALL TIMES.

FIRE/LIFE CLOSERS ARE TO BE TIED DIRECTLY TO THE FIRE ALARM SYSTEM.

Hardware Group No. 17

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	F-25-R-L-NL-DANE	626	FAL
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	OH STOP	100SE	630	GLY
1	EA	FIRE/LIFE CLOSER	4040SE 24V/120V AC/DC AS REQ PUSH SIDE	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER

FIRE/LIFE CLOSERS ARE TO BE TIED DIRECTLY TO THE FIRE ALARM SYSTEM.

Hardware Group No. 18

Provide each PR door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB	689	VON
1	EA	FIRE EXIT HARDWARE	F-25-R-EO	626	FAL
1	EA	FIRE EXIT HARDWARE	F-25-R-L-NL-DANE	626	FAL
1	EA	MULLION STORAGE KIT	MT54	689	VON
2	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
2	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 900-2RS (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

Hardware Group No. 19

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	FIRE EXIT HARDWARE	F-25-R-EO	626	FAL
1	EA	FIRE EXIT HARDWARE	F-25-R-L-NL-DANE	626	FAL
1	EA	MULLION STORAGE KIT	MT54	689	VON
2	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
2	EA	OH STOP	100SE	630	GLY
2	EA	FIRE/LIFE CLOSER	4040SE 24V/120V AC/DC AS REQ PUSH SIDE	689	LCN
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 900-2RS (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

FIRE/LIFE CLOSERS ARE TO BE TIED DIRECTLY TO THE FIRE ALARM SYSTEM.

Hardware Group No. 20

Provide each PR door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB	689	VON
2	EA	FIRE EXIT HARDWARE	F-25-R-L-DANE	626	FAL
1	EA	MULLION STORAGE KIT	MT54	689	VON
3	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
2	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	OH STOP	100SE	630	GLY
2	EA	FIRE/LIFE CLOSER	4040SE 24V/120V AC/DC AS REQ PUSH SIDE	689	LCN
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

FIRE/LIFE CLOSERS ARE TO BE TIED DIRECTLY TO THE FIRE ALARM SYSTEM.

Hardware Group No. 21

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB	689	VON
2	EA	FIRE EXIT HARDWARE	F-25-R-L-NL-DANE	626	FAL
1	EA	MULLION STORAGE KIT	MT54	689	VON
3	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
2	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	SURFACE CLOSER	1461 EDA STD	689	LCN
1	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	626	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

Hardware Group No. 22

Provide each PR door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4023 STAB	SP28	FAL
1	EA	PANIC HARDWARE	CD-25-R-EO	626	FAL
1	EA	PANIC HARDWARE	CD-25-R-NL-OP	626	FAL
4	EA	SFIC PERMANENT CORE	1C7*2	626	BES
3	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
2	EA	90 DEG OFFSET PULL	8190EZHD 8" STD	630-316	IVE
2	EA	SURFACE CLOSER	1461 SHCUSH STD	689	LCN
2	EA	PA MOUNTING PLATE	1460-18PA SRT	689	LCN
2	EA	CUSH SHOE SUPPORT	1460-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	1460-61 SRT	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 900-2RS (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

Hardware Group No. 23

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY	628	IVE
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB	689	VON
1	EA	FIRE EXIT HARDWARE	F-25-R-EO	626	FAL
1	EA	FIRE EXIT HARDWARE	F-25-R-L-NL-DANE	626	FAL
2	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
2	EA	90 DEG OFFSET PULL	8190EZHD 8" STD	630-316	IVE
2	EA	OH STOP	100SE	630	GLY
2	EA	FIRE/LIFE CLOSER	4040SE 24V/120V AC/DC AS REQ PUSH SIDE	689	LCN
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 900-2RS (COORDINATE WITH ACCESS CONTROL)	LGR	SCE



OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

Hardware Group No. 24

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4023 STAB	SP28	FAL
1	EA	PANIC HARDWARE	CD-25-R-EO	626	FAL
1	EA	PANIC HARDWARE	CD-25-R-NL-OP	626	FAL
4	EA	SFIC PERMANENT CORE	1C7*2	626	BES
3	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	ELECTRIC STRIKE	9600 FSE	630	HES
2	EA	90 DEG OFFSET PULL	8190EZHD 8" STD	630-316	IVE
2	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
2	EA	PA MOUNTING PLATE	1460-18PA SRT	689	LCN
2	EA	CUSH SHOE SUPPORT	1460-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	1460-61 SRT	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 900-2RS (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

Hardware Group No. 25

Provide each PR door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4023 STAB	SP28	FAL
1	EA	PANIC HARDWARE	CD-25-R-EO	626	FAL
1	EA	PANIC HARDWARE	CD-25-R-NL-OP	626	FAL
4	EA	SFIC PERMANENT CORE	1C7*2	626	BES
3	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
2	EA	90 DEG OFFSET PULL	8190EZHD 8" STD	630-316	IVE
1	EA	OH STOP	100SE	630	GLY
1	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
1	EA	SURF. AUTO OPERATOR	4642 MTBMS 120 VAC	689	LCN
1	EA	PA MOUNTING PLATE	1460-18PA SRT	689	LCN
1	EA	CUSH SHOE SUPPORT	1460-30 SRT	689	LCN
1	EA	BLADE STOP SPACER	1460-61 SRT	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 900-2RS (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

CREDENTIAL READER DEVICE IS TO RELEASE ELECTRIC STRIKE AND ENABLE PULL SIDE ACTUATOR ALLOWING MANUAL OR AUTOMATIC INGRESS. IMMEDIATE MANUAL EGRESS IS ALWAYS AVAILABLE. PUSH SIDE ACTUATOR ALWAYS ENABLED. KEYED INGRESS IS ALSO AVAILABLE.

POWER FOR THE AUTO OPERATOR BY THE ELECTRICAL CONTRACTOR.

ITEMS TO BE PROVIDED BY THE DIVISION 28 SUPPLIER:  
 REQUIRED POWER AND WIRING TO THE ELECTRIC STRIKE.

Hardware Group No. 26

Provide each PR door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4023 STAB	SP28	FAL
1	EA	PANIC HARDWARE	CD-25-R-EO	626	FAL
1	EA	PANIC HARDWARE	CD-25-R-NL-OP	626	FAL
4	EA	SFIC PERMANENT CORE	1C7*2	626	BES
3	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
2	EA	90 DEG OFFSET PULL	8190EZHD 8" STD	630-316	IVE
2	EA	SURFACE CLOSER	1461 SCUSH STD	689	LCN
2	EA	PA MOUNTING PLATE	1460-18PA SRT	689	LCN
2	EA	CUSH SHOE SUPPORT	1460-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	1460-61 SRT	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 900-2RS (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED UPON LOSS OF POWER. FREE EGRESS AT ALL TIMES.

Hardware Group No. 27

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	LD-25-R-L-NL-DANE	626	FAL
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	1461 SCUSH STD ST-2693	689	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA-S JAMB SEAL SET	AA	ZER
1	EA	GASKETING	429AA HEAD SEAL MOUNT PRIOR TO ANY HEAD MOUNTED HARDWARE	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE



OPERATION: DOOR NORMALLY CLOSED AND LOCKED. SCHEDULED UNLOCKING AVAILABLE OR PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 28

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	LD-25-R-L-NL-DANE	626	FAL
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
1	EA	ELECTRIC STRIKE	9600 FSE	630	HES
1	EA	LOCK GUARD	LG10	630	IVE
1	EA	SURFACE CLOSER	1461 SCUSH STD ST-2693	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA-S JAMB SEAL SET	AA	ZER
1	EA	GASKETING	429AA HEAD SEAL	AA	ZER
			MOUNT PRIOR TO ANY HEAD MOUNTED HARDWARE		
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. SCHEDULED UNLOCKING AVAILABLE OR PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK THE ELECTRIC STRIKE ALLOWING ACCESS. DOOR TO REMAIN LOCKED AND LATCH UPON LOSS OF POWER OR SIGNAL FROM THE FIRE ALARM. FREE EGRESS AT ALL TIMES.

Hardware Group No. 29

Provide each RU door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
NOTE: PROVIDE THUMBTURN FOR INTERIOR. BALANCE OF HARDWARE BY DOOR SUPPLIER.					

Hardware Group No. 30

Provide each PR door(s) with the following:



QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	PANIC HARDWARE	CD-25-R-EO	626	FAL
1	EA	PANIC HARDWARE	CD-25-R-L-NL-DANE	626	FAL
1	EA	MULLION STORAGE KIT	MT54	689	VON
4	EA	SFIC PERMANENT CORE	1C7*2	626	BES
3	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	SURFACE CLOSER	1461 SCUSH STD ST-2693	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA-S JAMB SEAL SET	AA	ZER
1	EA	GASKETING	429AA HEAD SEAL MOUNT PRIOR TO ANY HEAD MOUNTED HARDWARE	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER

Hardware Group No. 31

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	FSA-F-25-R-L-DANE 24 VDC	626	FAL
1	EA	SFIC PERMANENT CORE	1C7*2	626	BES
1	EA	SFIC MORTISE CYL.	80-110	626	SCH
1	EA	SURFACE CLOSER	1461 REG OR PA AS REQ STD	689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1	EA	CREDENTIAL READER	BY OWNER		B/O
1	EA	POWER SUPPLY	PS902 FA900 (COORDINATE WITH ACCESS CONTROL)	LGR	SCE

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. PRESENTING A VALID CREDENTIAL TO THE READER WILL MOMENTARILY UNLOCK ELECTRIFIED LEVER TRIM ALLOWING ACCESS. DOOR TO UNLOCK AND REMAIN LATCH UPON LOSS OF POWER OR SIGNAL FROM FIRE ALARM. FREE EGRESS AT ALL TIMES.

**END OF SECTION**



## SECTION 08 80 00 - GLAZING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
- B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- C. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.
- D. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.
- E. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Mirrors.

#### 1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- F. ASTM C1036 - Standard Specification for Flat Glass.
- G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings.
- K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- L. GANA (SM) - GANA Sealant Manual.
- M. NFRC 100 - Procedure for Determining Fenestration Product U-factors.
- N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
- O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

- D. Samples: Submit one samples 12 by 12 inch in size of glass units.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Insulating Glass Units: One of each glass size and each glass type.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
  - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
  - 1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.

### **1.6 FIELD CONDITIONS**

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

### **1.7 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- C. Provide minimum two (2) year warranty against defects for materials and installation, unless otherwise indicated.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Glass Fabricators:
  - 1. Thompson I.G., LLC: [www.thompsonig.com/#sle](http://www.thompsonig.com/#sle).
  - 2. Trulite Glass & Aluminum Solutions, LLC: [www.trulite.com/#sle](http://www.trulite.com/#sle).
  - 3. Viracon, Inc: [www.viracon.com/#sle](http://www.viracon.com/#sle).
  - 4. Oldcastle Building Envelope; [www.obe.com](http://www.obe.com).
  - 5. Substitutions: Section 01 25 00 - Substitution Procedures.
- B. Float Glass Manufacturers:
  - 1. Cardinal Glass Industries: [www.cardinalcorp.com/#sle](http://www.cardinalcorp.com/#sle).
  - 2. Guardian Glass, LLC: [www.guardianglass.com/#sle](http://www.guardianglass.com/#sle).
  - 3. Pilkington North America Inc: [www.pilkington.com/na/#sle](http://www.pilkington.com/na/#sle).
  - 4. Saint Gobain North America: [www.saint-gobain.com/#sle](http://www.saint-gobain.com/#sle).
  - 5. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
  - 6. All products to be provided are contingent on meeting or exceeding performance requirements as stated..
  - 7. Substitutions: Section 01 25 00 - Substitution Procedures.

### **2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES**

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Design Pressure: Calculated in accordance with ASCE 7.
  2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
  3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
  4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
  5. Glass thicknesses listed are minimum.
- B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  3. Solar Optical Properties: Comply with NFRC 300 test method.

### 2.3 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
  2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
  3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
  4. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

### 2.4 INSULATING GLASS UNITS

- A. Manufacturers:
1. Glass: Any of the manufacturers specified for float glass.
  2. Guardian Glass, LLC: [www.guardianglass.com/#sle](http://www.guardianglass.com/#sle).
  3. Pilkington North America Inc: [www.pilkington.com/na/#sle](http://www.pilkington.com/na/#sle). Pilkington North America Inc: [www.pilkington.com/na/#sle](http://www.pilkington.com/na/#sle).
  4. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com/#sle](http://www.vitroglazings.com/#sle).
  5. Substitutions: Section 01 25 00 - Substitution Procedures.
- B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
- C. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
  2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
  3. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
    - a. Spacer Width: As required for specified insulating glass unit.
    - b. Spacer Height: Manufacturer's standard.
    - c. Products:
      - 1) H.B. Fuller Construction Products Inc; Kodispace 4SG: [www.hbfuller.com/#sle](http://www.hbfuller.com/#sle).
      - 2) Quanex IG Systems, Inc; Super Spacer TriSeal: [www.quanex.com/#sle](http://www.quanex.com/#sle).
      - 3) Technoform Glass Insulation; TGI-Spacer: [www.glassinsulation.us/#sle](http://www.glassinsulation.us/#sle).
  4. Spacer Color: Black.
  5. Edge Seal:

- a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
- b. Color: Black.
6. Purge interpane space with dry air, hermetically sealed.
- D. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
  1. Applications: Exterior glazing unless otherwise indicated.
  2. Space between lites filled with air.
  3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
    - a. Tint: Clear.
    - b. Coating: Low-E (passive type), on #2 surface.
  4. Warm-edge spacer.
  5. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
    - a. Tint: Clear.
  6. Total Thickness: 1 inch.
  7. Thermal Transmittance (U-Value), Winter - Center of Glass: .245, nominal.
  8. Visible Light Transmittance (VLT): 68 percent, nominal.
  9. Solar Heat Gain Coefficient (SHGC): 0.37, nominal.
  10. Glazing Method: Dry glazing method, gasket glazing.

## 2.5 GLAZING UNITS

- A. Type G-1 - Monolithic Safety Glazing: Non-fire-rated.
  1. Applications:
    - a. Glazed lites in doors, except fire doors.
    - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
    - c. Other locations required by applicable federal, state, and local codes and regulations.
    - d. Other locations indicated on drawings.
  2. Glass Type: Fully tempered safety glass as specified.
  3. Tint: Clear.
  4. Thickness: 1/4 inch, nominal.

## 2.6 GLAZING COMPOUNDS

- A. Type GC-1 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

## 2.7 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- D. Glazing Clips: Manufacturer's standard type.

## PART 3 EXECUTION

### 3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.



- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### **3.3 INSTALLATION, GENERAL**

- A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

### **3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)**

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### **3.5 FIELD QUALITY CONTROL**

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

### **3.6 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces in accordance with glass manufacturer's written recommendations.

### **3.7 PROTECTION**

- A. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

**END OF SECTION**



## **SECTION 09 05 61 - COMMON WORK RESULTS FOR FLOORING PREPARATION**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
  - 1. Resilient tile and sheet.
  - 2. Carpet tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
  - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.
- H. Remedial floor treatment.

#### **1.2 RELATED REQUIREMENTS**

#### **1.3 REFERENCE STANDARDS**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens).
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete.
- C. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application.
- D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings.

#### **1.4 SUBMITTALS**

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
  - 1. Moisture and alkalinity (pH) limits and test methods.
  - 2. Manufacturer's required bond/compatibility test procedure.
- C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
  - 1. Manufacturer's qualification statement.
  - 2. Certificate: Manufacturer's certification of compatibility with types of flooring applied over remedial product.
  - 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
  - 4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

- D. Testing Agency's Report:
  - 1. Description of areas tested; include floor plans and photographs if helpful.
  - 2. Summary of conditions encountered.
  - 3. Moisture and alkalinity (pH) test reports.
  - 4. Copies of specified test methods.
  - 5. Recommendations for remediation of unsatisfactory surfaces.
  - 6. Product data for recommended remedial coating.
  - 7. Certificate: Include certification of accuracy by authorized official of testing agency.
  - 8. Submit report to Architect.
  - 9. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.
- F. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.
- G. Copy of RFCI (RWP).

### **1.5 QUALITY ASSURANCE**

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
  - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
  - 2. Acceptable Testing Agencies:
    - a. Independent Floor Testing & Inspection, Inc. (IFTI): [www.ifti.com/#sle](http://www.ifti.com/#sle).
    - b. Other testing agency approved by Architect..
- C. Contractor's Responsibility Relating to Independent Agency Testing:
  - 1. Provide access for and cooperate with testing agency.
  - 2. Confirm date of start of testing at least 10 days prior to actual start.
  - 3. Allow at least 4 business days on site for testing agency activities.
  - 4. Achieve and maintain specified ambient conditions.
  - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

### **1.7 FIELD CONDITIONS**

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
  2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
  3. Products:
    - a. ARDEX Engineered Cements; ARDEX Feather Finish: [www.ardexamericas.com/#sle](http://www.ardexamericas.com/#sle).
    - b. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
    - c. LATICRETE International, Inc; SKIM LITE: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
    - d. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: [www.usg.com/#sle](http://www.usg.com/#sle).
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
  2. Use product recommended by testing agency.
- D. Remedial Floor Treatment: Penetrating, spray-applied, silicate-based product intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Use product recommended by testing agency.

## **PART 3 EXECUTION**

### **3.1 CONCRETE SLAB PREPARATION**

- A. Perform following operations in the order indicated:
1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
    - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
    - b. Removal of existing floor covering.
  2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
    - a. Prepare surface according to recommendations of remedial coating manufacturer and according to ASTM D4259.
  3. Preliminary cleaning.
  4. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
  5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.

6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
7. Specified remediation, if required.
8. Patching, smoothing, and leveling, as required.
9. Other preparation specified.
10. Adhesive bond and compatibility test.
11. Protection.

**B. Remediations:**

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

**3.2 REMOVAL OF EXISTING FLOOR COVERINGS**

- A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

**3.3 PRELIMINARY CLEANING**

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

**3.4 MOISTURE VAPOR EMISSION TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

**3.5 ALKALINITY TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
  1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.

2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
  3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

### **3.6 PREPARATION**

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

### **3.7 ADHESIVE BOND AND COMPATIBILITY TESTING**

- A. Comply with requirements and recommendations of floor covering manufacturer.

### **3.8 APPLICATION OF REMEDIAL FLOOR COATING**

- A. Comply with requirements and recommendations of coating manufacturer.

### **3.9 APPLICATION OF REMEDIAL FLOOR TREATMENT**

- A. Comply with requirements and recommendations of treatment manufacturer.

### **3.10 PROTECTION**

- A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION**





## SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Gypsum sheathing.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 06 10 00 - Rough Carpentry: Building framing and sheathing.
- C. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- D. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.
- E. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- F. Section 09 22 16 - Non-Structural Metal Framing.

#### 1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- G. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board.
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- K. GA-216 - Application and Finishing of Gypsum Panel Products.
- L. GA-226 - Application of Gypsum Board to Form Curved Surfaces.
- M. ICC (IBC) - International Building Code.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
  - 1. Provide data on gypsum board, accessories, and joint finishing system and all materials furnished and installed under this Section.
  - 2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
  - 3. Manufacturer's recommended installation procedures.
- C. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Products shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on non-wicking supports, in accordance with manufacturer's recommendations.
- B. Store metal products to prevent corrosion.

## PART 2 PRODUCTS

### 2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
  - 1. See PART 3 for finishing requirements.
- B. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code. Also as listed on drawings.
  - 1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.

### 2.2 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
  - 1. CertainTeed Corporation; Saint-Gobain North America.
  - 2. Continental Building Products; Saint-Gobain North America.
  - 3. Georgia-Pacific Gypsum.
  - 4. Gold Bond Building Products, LLC provided by National Gypsum Company.
  - 5. USG Corporation: [www.usg.com/#sle](http://www.usg.com/#sle).
  - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
  - 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
  - 4. Thickness:
    - a. Vertical Surfaces: 5/8 inch.
    - b. Ceilings: 5/8 inch.

- C. Exterior Sheathing Board: See Section 06 10 00.

### 2.3 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: See Section 07 21 00.
- B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
  2. Tape Thickness: 1/4 inch.
- C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- D. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, rolled zinc, or vinyl, PVC-based composite, unless noted otherwise.
1. Corner Beads: Low profile, for 90 degree outside corners.
  2. L-Trim with Tear-Away Strip: Sized to fit 5/8"-inch thick gypsum wallboard.
  3. Expansion (Control) Joints:
    - a. Type: V-shaped metal with factory-installed protective tape.
- E. Decorative Metal Trim:
1. Material: Extruded aluminum alloy 6063-T5 temper.
  2. Finish: Anodized, clear.
  3. Type: As indicated on drawings.
    - a. Products:
      - 1) Fry Reglet.
      - 2) Gordon Inc.
- F. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
  2. 10-by-10 Glass Mesh: For Glass Mat Gypsum sheathing Board.
  3. Tile Backing Panels: As recommended by Manufacturer.
  4. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on Previous or for successive coats.
    - a. Pre-filling: At open joints and damaged surface areas, use setting-type taping compound.
    - b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound as recommended by manufacturer.
      - 1) Use setting-type compound for installing paper-faced metal trim accessories.
    - c. Fill Coat: For second coat, use setting-type, sand-able topping or drying-type, all-purpose compound as recommended by manufacturer.
    - d. Finish Coat: For third coat, use setting-type, sand-able topping or drying-type, all purpose compound as recommended by manufacturer.
    - e. Skim Coat: For final coat of Level 5 finish, use setting-type, sand-able topping compound, drying-type, all-purpose compound, or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish as recommended by manufacturer.
- G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.
- H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

- I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.

#### **3.2 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.

#### **3.3 BOARD INSTALLATION**

- A. Comply with ASTM C754, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Installation on Metal Framing: Use screws for attachment of gypsum board.
- E. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

#### **3.4 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
  1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
  2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.
- D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

#### **3.5 JOINT TREATMENT**

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
  2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.



### **3.6 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

### **3.7 CLEANING**

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. At completion of each section of work, clean area of scraps, dust, debris and surplus materials to prevent tracking onto floor surfaces..

### **3.8 PROTECTION**

- A. Protect installed gypsum board assemblies from subsequent construction operations.

**END OF SECTION**



## SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- B. Section 09 21 16 - Gypsum Board Assemblies: Execution requirements for anchors for attaching work of this section.

#### 1.3 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
- B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data.
- C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- J. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
  - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. SSFSA Manufacturer Qualification: Submit documentation of manufacturer association membership.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.
- B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA):.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
  - 1. ClarkDietrich.
  - 2. MarinoWARE.
  - 3. MBA Metal Framing.
  - 4. MRI Steel Framing LLC.
  - 5. State Building Products.
  - 6. Steel Stud Solutions.
  - 7. Telling Industries.

### 2.2 FRAMING MATERIALS

- A. Fire-Resistance-Rated Assemblies: Comply with applicable code and as indicated on drawings.
- B. Loadbearing Studs: As specified in Section 05 40 00.
- C. Design framing systems in accordance with AISI S220 and ASTM C645, Section 10, unless otherwise indicated.
- D. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 and ASTM C645, Section 10.
  - 1. Corrosion Protection Coating Designation: G60, or equivalent in accordance with AISI S220 and ASTM C645, Section 10.
    - a. Coating to demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- E. Material and Product Requirements Criteria: AISI S201.
- F. Non-Loadbearing Framing System Components: AISI S220 and ASTM C645, Section 10; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
  - 1. Studs: C-shaped with flat faces.
    - a. Products:
      - 1) ClarkDietrich; ProSTUD Drywall Framing System with Smart Edge technology: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
      - 2) MarinoWARE; ViperStud Drywall Framing: [www.marinoware.com/#sle](http://www.marinoware.com/#sle).
      - 3) MBA Building Supplies; ProSTUD Drywall Framing System: [www.mbastuds.com/#sle](http://www.mbastuds.com/#sle).
      - 4) State Building Products.
      - 5) Steel Stud Solutions.
      - 6) Telling Industries.
  - 2. Runners: U-shaped, sized to match studs.
  - 3. Ceiling Channels: C-shaped.
  - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
  - 5. Products:
    - a. ClarkDietrich; Furring Channel.
- G. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.



1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code when evaluated in accordance with AISI S100.
  2. Material: ASTM A653/A653M steel sheet, SS Grade 50.
  3. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
- H. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
1. Products:
    - a. ClarkDietrich; BlazeFrame Firestop Deflection Track: [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
- I. Preformed Top Track Firestop Seal:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
  2. Products:
    - a. ClarkDietrich; BlazeFrame Tape.
    - b. Hilti, Inc; Top Track Seal CFS TTS: [www.us.hilti.com/#sle](http://www.us.hilti.com/#sle).
    - c. Specified Technologies Inc; SpeedFlex TTG Track Top Gasket: [www.stfirestop.com/#sle](http://www.stfirestop.com/#sle).
- J. Non-Loadbearing Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
  2. Bracing and Bridging: ASTM A653/A653M G90 galvanized steel; for lateral bracing of wall studs with slots for engaging on-module studs.
    - a. Products:
      - 1) ClarchDietrich; Spazzer 5400 Bridging Bar (SPS)
      - 2) Simpson Strong-Tie; DBR Drywall Spacer Bracer: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  3. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.
    - a. Products:
      - 1) ClarkDietrich; FastBridge Clip (FB33): [www.clarkdietrich.com/#sle](http://www.clarkdietrich.com/#sle).
  4. Fasteners: ASTM C1002 self-piercing self-tapping screws.
  5. Anchorage Devices: Powder actuated.
  6. Acoustic Insulation: See Section 07 21 00.
  7. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
  8. Touch-Up Primer for Corrosion Protected Surfaces: SSPC-Paint 20 Type I - Inorganic.
- K. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
  2. Tape Thickness: 1/4 inch.
  3. Products:
    - a. Armacell LLC; ArmaComfort MTD: [www.armacell.us/#sle](http://www.armacell.us/#sle).

## 2.3 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

### 3.2 INSTALLATION OF STUD FRAMING

- A. Install non-structural members in accordance with ASTM C754.
- B. Extend partition framing to structure in all locations.
- C. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Align and secure top and bottom runners at 24 inches on center.
- E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- F. Install studs vertically at spacing indicated on drawings.
- G. Align stud web openings horizontally.
- H. Secure studs to tracks using crimping method. Do not weld.
- I. Stud splicing is not permissible.
- J. Fabricate corners using a minimum of three studs.
- K. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- L. Brace stud framing system rigid.
- M. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- N. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- O. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.
- P. Furring: Coordinate with sound isolation clip spacing and locations. Lap splices a minimum of 6 inches.

### 3.3 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated.
- E. Space main carrying channels at maximum 72 inches on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
- H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- I. Laterally brace suspension system.

### 3.4 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.



- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.  
**END OF SECTION**



## SECTION 09 30 00 - TILING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Cementitious backer board as tile substrate.
- E. Ceramic accessories.
- F. Non-ceramic trim.

#### 1.2 RELATED REQUIREMENTS

#### 1.3 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium).
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.
- C. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
- D. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation.
- E. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.
- F. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
- G. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar.
- H. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.
- I. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar.
- J. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.
- K. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Installer's Qualification Statement:
  - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
  - 2. Submit documentation of completion of apprenticeship and certification programs.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Tile: 1 percent of each size, color, and surface finish combination.

### 1.5 QUALITY ASSURANCE

- A. Maintain one copy of ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Installer Qualifications:
  - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
    - a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).
  - 2. Installer Certification:
    - a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
    - b. Apprenticeship Program: Installer has achieved Journeyworker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.
    - c. Advanced Certifications for Tile Installers (ACT): Certification in the installation of membranes, mortar bed (mud) floors, mortar (mud) walls, shower receptors, large format tile, gauged porcelain tile/panels/slabs, and grouts.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

### 1.7 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

## PART 2 PRODUCTS

### 2.1 TILE

- A. Manufacturers: All products by the same manufacturer.
  - 1. As indicated on Finish Legend.
- B. Porcelain Tile PWT1: ANSI A137.1 standard grade.
  - 1. Size: 4 X 8 Inch, nominal.
  - 2. Color(s): As indicated on drawings.
- C. Porcelain Tile PWT2: ANSI A137.1 standard grade.
  - 1. Size: 4 X 12 Inch, nominal.
  - 2. Color(s): As indicated on drawings.
- D. Porcelain Tile PWT3: ANSI A137.1 standard grade.
  - 1. Size: 12 X 48 Inch, nominal.
  - 2. Color(s): As indicated on drawings.

### 2.2 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
  - 1. Soap Dish: With handle, clam shell design, recess mounted; cast strength sufficient to resist lateral pull force of 75 lbs.
- B. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
  - 1. Applications:
    - a. Open edges of wall tile.
    - b. Open edges of floor tile.
    - c. Wall corners, outside and inside.

- d. Transition between floor finishes of different heights.
- e. Floor to wall joints.
- 2. Manufacturers:
  - a. Schluter-Systems: [www.schluter.com/#sle](http://www.schluter.com/#sle).

### 2.3 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
  - 1. Custom Building Products: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
  - 2. H.B. Fuller Construction Products, Inc: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
  - 3. LATICRETE International, Inc: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
- C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
  - 1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.
  - 2. Products:
    - a. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
    - b. H.B. Fuller Construction Products, Inc; TEC TotalFlex 150 Universal Mortar: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
    - c. LATICRETE International, Inc; MULTIMAX LITE: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
- D. Mortar Bond Coat For Exterior Glue Plywood: ANSI A118.11.
  - 1. Applications: Use this type of bond coat where thin-set installation is indicated over plywood.
  - 2. Products:
    - a. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
    - b. LATICRETE International, Inc; LATICRETE 254 Platinum: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).

### 2.4 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
  - 1. Custom Building Products: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
  - 2. H.B. Fuller Construction Products, Inc: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
  - 3. LATICRETE International, Inc: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
- C. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
  - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
  - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
  - 3. Color(s): As indicated on drawings.
  - 4. Products:
    - a. Custom Building Products; Prism Color Consistent Grout: [www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
    - b. H.B. Fuller Construction Products, Inc; TEC AccuColor Plus Grout: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
    - c. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
- D. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
  - 1. Color(s): As indicated on drawings.
  - 2. Products:

- a. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout:  
[www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
- b. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Special Effects Grout: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
- c. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout:  
[www.laticrete.com/#sle](http://www.laticrete.com/#sle).

## 2.5 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
  1. Applications: Between tile and plumbing fixtures.
  2. Color(s): As selected by Architect from manufacturer's full line.
  3. Products:
    - a. Custom Building Products; Commercial 100% Silicone Caulk:  
[www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).
    - b. LATICRETE International, Inc; LATICRETE LATASIL: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
  1. Composition: Water-based colorless silicone.
  2. Color(s): As selected by Architect from manufacturer's full line.
  3. Products:
    - a. STONETECH, a Division of LATICRETE International, Inc; STONETECH Heavy Duty Grout Sealer: [www.laticrete.com/#sle](http://www.laticrete.com/#sle).

## 2.6 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
  1. Crack Resistance: No failure at 1/8 inch gap, minimum.
  2. Fluid or Trowel Applied Type:
    - a. Thickness: 20 mils, maximum.
    - b. Products:
      - 1) H.B. Fuller Construction Products, Inc; TEC HydraFlex Waterproofing Crack Isolation Membrane: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
      - 2) LATICRETE International, Inc; LATICRETE FRACTURE BAN SC:  
[www.laticrete.com/#sle](http://www.laticrete.com/#sle).
- B. Waterproofing Membrane at Showers and Tiled Tubs: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
  1. Fluid or Trowel Applied Type:
    - a. Material: Acrylic.
    - b. Thickness: 25 mils, minimum, dry film thickness.
    - c. Products:
      - 1) LATICRETE International, Inc; LATICRETE HYDRO BAN:  
[www.laticrete.com/#sle](http://www.laticrete.com/#sle).
      - 2) USG Corporation; Durock Brand Liquid Waterproofing Membrane:  
[www.usg.com/#sle](http://www.usg.com/#sle).
- C. Reinforcing Mesh: 2 by 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- D. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
  1. Products:
    - a. Custom Building Products; WonderBoard Lite Backerboard:  
[www.custombuildingproducts.com/#sle](http://www.custombuildingproducts.com/#sle).



## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

### **3.2 PREPARATION**

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

### **3.3 INSTALLATION - GENERAL**

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

### **3.4 INSTALLATION - SHOWERS AND BATHTUB WALLS**

- A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. Grout with standard grout as specified above.

### **3.5 INSTALLATION - WALL TILE**

- A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.
- B. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms, kitchens, and locker rooms.
- C. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

### **3.6 CLEANING**

- A. Clean tile and grout surfaces.



### **3.7 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION**

## SECTION 09 51 00 - ACOUSTICAL CEILINGS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

#### 1.2 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Not required unless submitting alternate product.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

#### 1.4 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### 1.5 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acoustic Tiles/Panels:
  - 1. Armstrong World Industries, Inc: [www.armstrongceilings.com/#sle](http://www.armstrongceilings.com/#sle).
  - 2. USG Corporation: [www.usg.com/ceilings/#sle](http://www.usg.com/ceilings/#sle).
- B. Suspension Systems:
  - 1. Same as for acoustical units.

#### 2.2 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels ACT1: Painted mineral fiber, with the following characteristics:
  - 1. Classification: ASTM E1264 Type III.
  - 2. Size: 24 by 24 inches.
  - 3. Thickness: 5/8 inch.
  - 4. NRC Range: 80 to 95, determined in accordance with ASTM E1264.
  - 5. Panel Edge: Square.
  - 6. Color: White.
  - 7. Suspension System: Exposed grid.
  - 8. Products:

- a. As specified in Finish Legend. .
- C. Acoustical Panels ACT2: Mineral fiber with scrubbable finish, with the following characteristics:
  - 1. Classification: ASTM E1264 Type IX.
  - 2. Size: 24 by 24 inches.
  - 3. Thickness: 5/8 inch.
  - 4. Panel Edge: Square.
  - 5. Suspension System: Exposed grid.
  - 6. Products:
    - a. As specified in Finish Legend.

### **2.3 SUSPENSION SYSTEM(S)**

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
  - 1. Materials:
    - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

### **2.4 ACCESSORIES**

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Perimeter Moldings: Same metal and finish as grid.
  - 1. Size: As required for installation conditions.
- E. Touch-up Paint: Type and color to match acoustical and grid units.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### **3.2 PREPARATION**

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

### **3.3 INSTALLATION - SUSPENSION SYSTEM**

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
- C. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- D. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- F. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- G. Do not eccentrically load system or induce rotation of runners.



### **3.4 INSTALLATION - ACOUSTICAL UNITS**

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
  - 1. Make field cut edges of same profile as factory edges.

### **3.5 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

### **3.6 CLEANING**

- A. Clean surfaces.
- B. Replace damaged or abraded components.

**END OF SECTION**



## SECTION 09 65 00 - RESILIENT FLOORING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Resilient stair accessories.
- E. Installation accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

#### 1.3 REFERENCE STANDARDS

- A. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile.
- B. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing.
- C. ASTM F1861 - Standard Specification for Resilient Wall Base.
- D. ASTM F2169 - Standard Specification for Resilient Stair Treads.
- E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Samples: Not required unless submitted product varies from specified product in Finish Legend.
- E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- F. Installer's Qualification Statement.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Flooring Material: 5 square feet of each type and color.
  - 2. Extra Wall Base: 5 linear feet of each type and color.
  - 3. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

### 1.7 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

## PART 2 PRODUCTS

### 2.1 SHEET FLOORING

- A. Rubber Sheet Flooring RSG1/RSG2/RSG3: 100 percent rubber composition, color and pattern through total thickness.
  - 1. Manufacturers:
  - 2. Minimum Requirements: Comply with ASTM F1859, Type 1, without backing.
  - 3. Thickness: 0.14in minimum.
  - 4. Surface Texture: Hammered.
  - 5. Color: As indicated on drawings.

### 2.2 TILE FLOORING

- A. Vinyl Tile LVT1: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
  - 1. Manufacturers:
    - a. Mohawk Group.
  - 2. Minimum Requirements: Comply with ASTM F1700, Class III.
  - 3. Plank Tile Size: 12 x 24 inch.
  - 4. Wear Layer Thickness: 20 mil.
  - 5. Total Thickness: 2.5mm.
  - 6. Tile Edge: Micro Beveled.
  - 7. Pattern: As indicated on drawings.
  - 8. Color: As indicated on drawings.
- B. Vinyl Tile LVT2 / LVT3: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
  - 1. Manufacturers:
    - a. Interface Inc,
  - 2. Minimum Requirements: Comply with ASTM F1700, Class III.
  - 3. Plank Tile Size: 9.845 x 39.38 inch.
  - 4. Wear Layer Thickness: 22 mil.
  - 5. Total Thickness: 4.5mm.
  - 6. Pattern: As indicated on drawings.
  - 7. Color: As indicated on drawings.

### 2.3 STAIR COVERING

- A. Stair Treads with Integral Risers RST1: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
  - 1. Manufacturers:
    - a. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
  - 2. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
  - 3. Nosing: Angled.
  - 4. Striping: 2 inch wide contrasting color abrasive strips.
  - 5. Tread Texture: Raised.
  - 6. Tread Pattern: Square.
  - 7. Color: As indicated on drawings.



## 2.4 RESILIENT BASE

- A. Resilient Base RB1: ASTM F1861, Type TP, rubber, thermoplastic; style as scheduled.
  - 1. Manufacturers:
    - a. Johnsonite, a Tarkett Company: [www.johnsonite.com/#sle](http://www.johnsonite.com/#sle).
  - 2. Height: 4 inches.
  - 3. Thickness: 0.125 inch.
  - 4. Finish: Satin.
  - 5. Length: Roll.
  - 6. Color: As indicated on drawings.

## 2.5 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Adhesive for Vinyl Flooring:
  - 1. Manufacturers:
    - a. H.B. Fuller Construction Products, Inc; TEC Flexera 2K PSA Hybrid Adhesive: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
- C. Moldings, Transition and Edge Strips: Resilient.
  - 1. Manufacturers:
    - a. Mannington Commercial: [www.manningtoncommercial.com/#sle](http://www.manningtoncommercial.com/#sle).
    - b. Schluter-Systems; VinPro: [www.schluter.com/#sle](http://www.schluter.com/#sle).

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
  - 1. Test in accordance with Section 09 05 61.
  - 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

### 3.2 PREPARATION

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
- B. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

### 3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
  - 1. Fit joints and butt seams tightly.
  - 2. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Resilient Strips: Attach to substrate using adhesive.

- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. At movable partitions, install flooring under partitions without interrupting floor pattern.

### **3.4 INSTALLATION - SHEET FLOORING**

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Cut sheet at seams in accordance with manufacturer's instructions.

### **3.5 INSTALLATION - TILE FLOORING**

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

### **3.6 INSTALLATION - RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.

### **3.7 INSTALLATION - STAIR COVERINGS**

- A. Install stair coverings in one piece for full width and depth of tread.
- B. Adhere over entire surface. Fit accurately and securely.

### **3.8 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

### **3.9 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION**

## SECTION 09 67 00 - FLUID-APPLIED FLOORING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fluid-applied flooring and base.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

#### 1.3 REFERENCE STANDARDS

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- C. Samples: Physical sample not required unless submitting alternate product.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Applicator's Qualification Statement.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

#### 1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section.
  - 1. Approved by manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resin materials in a dry, secure area.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.

#### 1.7 FIELD CONDITIONS

- A. Maintain minimum temperature in storage area of 55 degrees F.
- B. Store materials in area of installation for minimum period of 24 hours prior to installation.
- C. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Fluid-Applied Flooring:
  - 1. Sherwin-Williams High-Performance Flooring: [www.sherwin-williams.com/resin-flooring/#sle](http://www.sherwin-williams.com/resin-flooring/#sle).

#### 2.2 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring Type RES1: Epoxy, moisture tolerant, with broadcast aggregate.
  - 1. Aggregate: Vinyl flakes.
  - 2. Top Coat: Compatible with basecoat and as recommended by manufacturer.

3. System Thickness: 1/4 inch, nominal, dry film thickness (DFT).
4. Texture: Orange peel in main areas, slip resistant in shower locations.
5. Sheen: Satin.
6. Color: As indicated on Finish Legend..
7. Basis of Design Product: Sherwin Williams, Resuflor Screed Deco Flake II

### **2.3 ACCESSORIES**

- A. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- B. Primer: Type recommended by fluid-applied flooring manufacturer.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive flooring.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
  1. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.
  2. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
- E. Verify that required floor-mounted utilities are in correct location.

### **3.2 PREPARATION**

- A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.
- D. Apply primer to surfaces required by flooring manufacturer.

### **3.3 INSTALLATION - FLOORING**

- A. Apply in accordance with manufacturer's instructions.
- B. Apply each coat to minimum thickness required by manufacturer.
- C. Finish to smooth level surface.
- D. Cove at vertical surfaces.

### **3.4 PROTECTION**

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.

**END OF SECTION**

## SECTION 09 68 13 - TILE CARPETING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 05 61 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

#### 1.3 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate layout of joints.
- D. Physical Samples not required unless submitting alternate product.
- E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- F. Installer's Qualification Statement.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

#### 1.6 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Tile Carpeting:
  - 1. Mannington Commercial: [www.manningtoncommercial.com#sle](http://www.manningtoncommercial.com#sle).
  - 2. Milliken & Company: [www.milliken.com/#sle](http://www.milliken.com/#sle).
  - 3. J+J Flooring.

#### 2.2 MATERIALS

- A. Tile Carpeting CT1: Loop, manufactured in one color dye lot.
  - 1. Tile Size: 24 x 24 Inch, nominal.
  - 2. Thickness: .091 inch.
  - 3. Color: As indicated on Finish Legend.
  - 4. Pattern: As indicated on Finish Legend.
  - 5. Dye method: Solution Dyed

6. Fiber System: Nylon 6
  7. Gauge: 5/64 inch.
  8. Stitches: 8.33 per inch.
  9. Pile Weight: 14 oz/sq yd.
  10. Primary Backing Material: Infinity 2.
- B. Tile Carpeting CT2: Textile Composite, manufactured in one color dye lot.
1. Tile Size: 18 x 36 Inch, nominal.
  2. Thickness: [.205] inch.
  3. Color: [As indicated on Finish Legend].
  4. Pattern: [As indicated on Finish Legend].
  5. Dye method: Solution Dyed
  6. Primary Backing Material: Polyester Felt Cushion
- C. Tile Carpeting CT3: Tufted, Cut Pile, manufactured in one color dye lot
1. Tile Size: 19.7 x 19.7 Inch, nominal.
  2. Thickness: [.50] inch.
  3. Gauge: [5/32] inch.
  4. Stitches: [5.6] per inch.
  5. Color: [As indicated on Finish Legend].
  6. Pattern: [As indicated on Finish Legend].
  7. Dye method: PrintWorks Precision Dye
  8. Primary Backing Material: PVC-Free WellBAC Comfort Plus Cushion
- D. Tile Carpeting CT4/CT5: Textured Patterned Loop, manufactured in one color dye lot
1. Tile Size: 18 x 36 Inch, nominal.
  2. Thickness: [.058] inch.
  3. Gauge: [5/64] inch.
  4. Stitches: [10.17] per inch.
  5. Color: [As indicated on Finish Legend].
  6. Pattern: [As indicated on Finish Legend].
  7. Fiber System: Nylon 6,6
  8. Dye method: Solution Dyed
  9. Primary Backing Material: Infinity 2.

## 2.3 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, color as selected by Architect.
- C. Adhesives:
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
  1. Test as Follows:
    - a. Alkalinity (pH): ASTM F710.
    - b. Internal Relative Humidity: ASTM F2170.
    - c. Moisture Vapor Emission: ASTM F1869.

2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

- D. Verify that required floor-mounted utilities are in correct location.

### **3.2 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.

### **3.3 INSTALLATION**

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

### **3.4 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

**END OF SECTION**





## SECTION 09 91 13 - EXTERIOR PAINTING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
  - 5. Floors, unless specifically indicated.
  - 6. Glass.
  - 7. Concealed pipes, ducts, and conduits.

#### 1.2 REFERENCE STANDARDS

- A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.

### PART 2 PRODUCTS

#### 2.1 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
  - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
  - 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

#### 3.2 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.



- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

**END OF SECTION**

## SECTION 09 91 23 - INTERIOR PAINTING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
  - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
  - 2. Surfaces inside cabinets.
  - 3. Mechanical and Electrical:
    - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
  - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
  - 2. Items indicated to receive other finishes.
  - 3. Items indicated to remain unfinished.
  - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
  - 5. Floors, unless specifically indicated.
  - 6. Glass.
  - 7. Concealed pipes, ducts, and conduits.

#### 1.2 RELATED REQUIREMENTS

#### 1.3 REFERENCE STANDARDS

- A. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual.
- C. SSPC-SP 1 - Solvent Cleaning.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
  - 2. MPI product number (e.g., MPI #47).
  - 3. Cross-reference to specified paint system products to be used in project; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
- D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

### **1.5 QUALITY ASSURANCE**

- A. Applicator Qualifications: Company specializing in performing the type of work specified approved by manufacturer.

### **1.6 MOCK-UP**

- A. Locate where directed by Architect.
- B. Mock-up may remain as part of the work.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

### **1.8 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 fc measured mid-height at substrate surface.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  1. Sherwin-Williams Company: [www.sherwin-williams.com/#sle](http://www.sherwin-williams.com/#sle).

### **2.2 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
  1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  2. Supply each paint material in quantity required to complete entire project's work from a single production run.
  3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- C. Colors: As indicated on drawings.
  1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

## 2.3 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, and uncoated steel.
1. Two top coats and one coat primer.
  2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
    - a. Products:
      - 1) Sherwin-Williams ProMar 200 HP Series, Eg-Shel. (MPI #139)
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
  2. Two top coats and one coat primer.
  3. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
    - a. Products:
      - 1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)
- C. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including gypsum board, plaster, concrete, concrete masonry units, uncoated steel, shop primed steel, galvanized steel, and aluminum.
1. Two top coats and one coat primer.
  2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
    - a. Products:
      - 1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
- D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
1. Shop primer by others.
  2. One top coat.
  3. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
    - a. Products:
      - 1) Sherwin-Williams Pro Industrial Multi-Surface Acrylic, Eg-Shel. (MPI #155)
- E. Paint I-TR-C - Transparent Finish on Concrete Floors.
1. 2 coats sealer over 1 coat stain.
  2. Stain: Solid Color Stain for Concrete.
    - a. Products:
      - 1) PPG Paints Perma-Crete Color Seal WB Interior/Exterior Acrylic Concrete Stain, 4-4210XI Series, Satin.
  3. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
    - a. Products:
      - 1) PPG Paints Perma-Crete Plex-Seal WB Interior/Exterior Clear Sealer, 4-6200XI, Satin. (MPI #99)
      - 2) Sherwin-Williams H&C Clarishield Water-Based Wet-Look Concrete Sealer. (MPI #99)
  4. Sealer Sheen:
    - a. Eggshell: MPI gloss level 3; use this sheen at all locations.

## 2.4 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

## 2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been adequately prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
  - 1. Gypsum Wallboard: 12 percent.
  - 2. Plaster and Stucco: 12 percent.
  - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
  - 4. Concrete Floors and Traffic Surfaces: 8 percent.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
  - 3. Clean concrete according to ASTM D4258. Allow to dry.
  - 4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- G. Masonry:
  - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
  - 2. Prepare surface as recommended by top coat manufacturer.
  - 3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi at 6 to 12 inches. Allow to dry.
- H. Preparation of Existing Epoxy Painted Masonry block or Face Brick:
  - 1. Pole sand with 100 grit sandpaper.
  - 2. Vacuum and wipe down surface to remove dust.
  - 3. Prime with urethane modified acrylic primer/sealer/bonder.

- I. Preparation of Existing Painted Masonry Block (where greater than 10% of paint failed to adhere in adhesion test):
  - 1. Abrade surface to create surface profile
  - 2. Vacuum and wipe down surface to remove dust
  - 3. Prime with adhesion promoting primer
  - 4. Repeat adhesion test
- J. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- K. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- L. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.
- M. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- N. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- O. Galvanized Surfaces:
- P. Ferrous Metal:
  - 1. Solvent clean according to SSPC-SP 1.
  - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- Q. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- R. Preparation of Existing Wall Tile to be Painted
  - 1. Replace cracked, chipped, or otherwise broken tiles and with new tiles of similar surface texture, pattern, and dimension.
  - 2. Infill areas of missing tile with new tiles of similar surface texture, pattern, and dimension.
  - 3. Identify wall openings in tiled walls that will require infill of new wall/ substrate material and coordinate with construction manager to ensure that new substrate is suitable to receive a seamless tile patch.
  - 4. Fill holes 1/4" or less in diameter with Portland Cement grout to provide uniform surface texture.
  - 5. Tiles with holes larger than 1/4 inch shall be replaced with new tile of similar texture, pattern, and dimension.
  - 6. Pole sand with 100 grit sandpaper.
  - 7. Vacuum and wipe down surface to remove dust.
  - 8. Prime with urethane modified acrylic primer/sealer/bonder.
- S. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

### 3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspect and test questionable coated areas.

### **3.5 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

### **3.6 PROTECTION**

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

### **3.7 SCHEDULE - PAINT SYSTEMS**

- A. Concrete, Concrete Masonry Units (CMU), Concrete Block, Brick Masonry: Finish surfaces exposed to view.
  - 1. Interior: CI-OP-3L, semi-gloss.
- B. Gypsum Board: Finish surfaces exposed to view.
  - 1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
  - 2. Interior Walls: GI-OP-3A, semi-gloss.
- C. Wood: Finish surfaces exposed to view.
  - 1. Interior Trim and Frames: WI-OP-3A, semi-gloss.
- D. Steel Doors and Frames: Finish surfaces exposed to view; MI-OP-3A, gloss.
- E. Steel Fabrications: Finish surfaces exposed to view and to concealed surfaces where required to conform to performance requirements and resist corrosion.
  - 1. Interior: MI-OP-3L, gloss.
- F. Pipe and Duct Insulation Jackets: Finish surfaces exposed to view; FI-OP-2L, flat.

**END OF SECTION**



## SECTION 10 12 00 - DISPLAY CASES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Recessed display cases.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
- C. Section 09 22 16 - Non-Structural Metal Framing: Concealed supports in metal stud walls.

#### 1.3 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix).
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit complete printed data and installation details indicating products to be provided as specified.
- C. Shop Drawings: Submit complete installation details. Include dimensioned elevations.
- D. Samples: Submit samples of material and trim to illustrate finish, color, and texture.
- E. Specimen Warranty.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver display cases and materials to the Project site with manufacturer's protective crate covering and do not open until ready for use.
- B. Protect display cases before, during, and after installation. In case of damage, immediately provide necessary repairs and replacements.

#### 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify field measurements for recessed application for display cases before preparation of shop drawings and before fabrication to ensure proper installation.

#### 1.8 WARRANTY

- A. Provide five year manufacturer warranty against defects and in materials, finish product and workmanship.

### PART 2 PRODUCTS

#### 2.1 DISPLAY CASES

- A. Manufacturers:
  1. Claridge Products and Equipment, Inc: [www.claridgeproducts.com/#sle](http://www.claridgeproducts.com/#sle).
  2. MooreCo, Inc: [www.moorecoinc.com/#sle](http://www.moorecoinc.com/#sle).
  3. Nelson Adams NACO: <https://nelsonadamsnaco.com/#sle>.

- B. Recessed Display Case: Factory-fabricated wood-framed display case with adjustable glass shelves, finished interior, and wood trim on face to cover edge of recessed opening.
  - 1. Components:
    - a. Glazed Doors: Sliding.
      - 1) Number of Doors: Two pair.
    - b. Side Panels: Stained veneer plywood.
    - c. Back Panel: Stained veneer plywood.
    - d. Top Panel: Stained veneer plywood.
    - e. Bottom Panel: Stained veneer plywood.
    - f. Lighting: LED.

## 2.2 COMPONENTS

- A. Wood Case Construction: 3/4 inch 7-ply Birch veneer plywood with manufacturer's custom stain.
- B. Glazed Sliding Doors:
  - 1. 1/4 inch clear tempered glass with plastic finger pulls.
  - 2. Door track: Extruded aluminum glass shoe with bottom rollers and top plastic guide.
  - 3. Lock: Glass door cylinder lock.
- C. Glass Shelves:
  - 1. 1/4 inch clear tempered glass with flat-polished edges.
  - 2. Shelf Depth: As indicated on drawings.
- D. Shelf Standards and Brackets: Single-slotted channel standards for brackets adjustable in 1 inch increments along entire length of standard, drilled and countersunk for screws.
  - 1. Standards Mounting: Recess-mounted into back panel.
  - 2. Face Width: 5/8 inch.
  - 3. Material: 16 gauge, 0.0598 inch sheet steel.
  - 4. Lengths: As indicated on drawings.
  - 5. Finish: Anochrome.
  - 6. Brackets: Boltless with lip front; 16 gauge, 0.0598 inch sheet steel, reinforced, locking into slots; size to suit shelves; same finish as standards.
- E. Lighting: Manufacturer's standard LED light fixture housed at top of case with louvered aluminum access door with keyed lock.
  - 1. Recessed: Fixture with egg crate diffuser.
  - 2. Controls: On/Off using dedicated wall switch.

## 2.3 MATERIALS

- A. Aluminum Extrusions for Framing and Trim: Alloy as recommended by manufacturer for construction and specified finish; nominal 1/8 inch wall thickness.
- B. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper.
  - 1. Finish: Factory finished; AAMA 2603: Powder coat; color as selected by Architect.
- C. Plywood: Softwood plywood with veneer core, waterproof glue, 3/4 inch thick.
- D. Heat-Strengthened and Fully Tempered Glass: ASTM C1048, Kind FT.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Rough openings, electrical pre-wiring, and final finishing are by other trades.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide factory trained installers.
- C. Locate fastening devices to secure cases securely to back and sides of rough opening.



- D. Refer to drawings for display case mounting heights.
- E. Clean case and glass using manufacturers recommended procedures.

**3.3 ADJUSTING AND CLEANING**

- A. Verify that all accessories are installed as detailed for each unit.
- B. At completion of work, clean glass surfaces, back panels and trim in accordance with manufacturer's recommendations leaving units ready for use.

**END OF SECTION**



## SECTION 10 14 19 - DIMENSIONAL LETTER SIGNAGE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Dimensional letter signage.
- B. Illumination system.

#### 1.2 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.
- B. ADA Standards - 2010 ADA Standards for Accessible Design.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
  - 1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
  - 2. Show locations of electrical service connections.
  - 3. Include diagrams for power, signal, and control wiring.
- D. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment. Where color not specified, provide physical selection chart or chips of manufacturer's full range.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- F. Manufacturer's qualification statement.
- G. Delegated Design submittal including structural analysis calculations to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.
- H. Sample Warranty: for special warranty.
- I. Operations and maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sign failures including, but not limited to, failure of materials, workmanship, deterioration of finishes beyond normal weathering, delamination of sheet materials, separation of components for Five years from date of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package dimensional letter signs as required to prevent damage before installation.
- B. Store under cover and elevated above grade.
- C. Store tape adhesive at a normal room temperature of 68 to 72 degrees F.

#### 1.7 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

- B. Maintain minimum ambient temperature during and after installation.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Dimensional Letter Signs:
1. A.R.K. Ramos <https://arkramos.com>
  2. Gemini Cast Metal Letters <https://geminimade.com>
  3. APCO Graphics, Inc. [www.apcosigns.com](http://www.apcosigns.com)
  4. ASI Signage Innovations [www.asisignage.com](http://www.asisignage.com)
  5. Best Sign Systems, Inc. [www.bestsigns.com](http://www.bestsigns.com)
  6. Midwest Sign – Wayland, Michigan <https://midwestsignco.com>
  7. Postema Signs & Graphics – Grand Rapid, Michigan [www.postemasign.com](http://www.postemasign.com)
  8. Praise Companies, Inc. [www.praisesign.com](http://www.praisesign.com)
  9. SignArt, Inc. – Kalamazoo, Michigan. [www.signartinc.com](http://www.signartinc.com).
  10. Signs Now – Holland, Michigan <https://signsnow.com>
  11. Universal Sign Systems – Grand Rapids, Michigan [www.universalsignsystems.com](http://www.universalsignsystems.com)
  12. Valley City Sign – Comstock Park, Michigan [www.valleycitysign.com](http://www.valleycitysign.com)
  13. Architect pre-approved manufacturer of product meeting or exceeding specifications.

### **2.2 REGULATORY REQUIREMENTS**

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

### **2.3 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
1. Uniform Wind Load: As indicated on Drawings.
- B. Concentrated Horizontal Load: As indicated on Drawings.
1. Other Design Load: As indicated on Drawings.
  2. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal movements: for exterior fabricated channel dimensional characters allow for thermal movements from ambient and surface temperature changes of 120 deg F, ambient; 180 deg R, material surfaces.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for for location and application.

### **2.4 DIMENSIONAL LETTERS**

- A. Metal Letters (characters with uniform faces, defined corners, precisely cast profiles, and as follows):
1. Copy:Material: Bronze sheet, flat.
  2. Thickness: 1/8 inch minimum.
  3. Letter Height: As indicated on drawings.
  4. Text and Typeface:
    - a. Character Font: Helvetica, Arial, or other sans serif font.
  5. Finish: Brushed, satin.
  6. Color: As selected from manufacturer's full range.
  7. Mounting: Concealed fasteners.
  8. Copy:
- B. Plastic Letters (characters with uniform faces, defined corners eased or square, precisely formed, and as follows):
1. Material: Injection molded plastic.

2. Thickness: 1/8 inch minimum.
  3. Letter Height: As indicated on drawings.
  4. Text and Typeface:
    - a. Character Font: Helvetica, Arial, or other sans serif font.
  5. Finish: Semi-gloss.
  6. Color: As selected.
  7. Mounting: Concealed screws.
  8. Copy:
- C. Fabricated Channel Characters (characters with solid faces and/or sides or illuminated faces and/or sides):
1. Character Design: Metal face and returns (without warping, twisting or waving; uniform faces, defined corners, and precisely formed shapes; braced internally for stability and to meet structural performance requirements without surface distortion; including fasteners and as follows):

## **2.5 ACCESSORIES**

- A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.
- B. Tape Adhesive: Double-sided tape, permanent adhesive.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that electrical service is correctly sized and located to accommodate dimensional letter signs.
- C. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions after verifying surfaces and materials are clean, free of distortion or defects. Fill any and all holes with adhesive or sealant. Provide solid blocking as required at hollow surfaces.
- B. Install with horizontal edges level and vertical edges plumb.
- C. Coat concealed surfaces with corrosion protection bituminous paint when in contact with grout, concrete, masonry, or other dissimilar metals.
- D. Do not use or install exposed-to-view wiring or conduit.
- E. Locate dimensional letter signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- F. Protect from damage until construction completion; repair or replace damaged items.
- G. Remove temporary protective coverings and strippable films just prior to owner occupancy.

**END OF SECTION**





## SECTION 10 14 23 - PANEL SIGNAGE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Panel signage.

#### 1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
  - 1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
  - 2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
    - a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
    - b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
    - c. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit one sample of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.
- E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.
- F. Manufacturer's qualification statement.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store under cover and elevated above grade.
- D. Store tape adhesive at normal room temperature.

#### 1.6 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Panel Signage:

1. Best Sign Systems, Inc: [www.bestsigns.com/#sle](http://www.bestsigns.com/#sle).
2. FASTSIGNS International, Inc: [www.fastsigns.com/#sle](http://www.fastsigns.com/#sle).
3. Inpro Corporation: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).
4. Mohawk Sign Systems, Inc: [www.mohawksign.com/#sle](http://www.mohawksign.com/#sle).
5. Seton Identification Products: [www.seton.com/aec/#sle](http://www.seton.com/aec/#sle).
6. Takeform: [www.takeform.net/#sle](http://www.takeform.net/#sle).
7. Vista System LLC: [www.vistasystem.com/#sle](http://www.vistasystem.com/#sle).

## 2.2 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

## 2.3 PANEL SIGNAGE

- A. Panel Signage:
  1. Application: Room and door signs.
  2. Description: Flat signs with engraved panel media, tactile characters.
  3. Sign Size: As indicated on drawings.
  4. Total Thickness: 1/8 inch.
  5. Color and Font, unless otherwise indicated:
    - a. Character Font: Helvetica, Arial, or other sans serif font.
    - b. Character Case: Upper and lower case (title case).
    - c. Background Color: As scheduled.
    - d. Character Color: Contrasting color.
  6. Material: Laminated colored plastic engraved through face to expose core as background color.
  7. Profile: Flat panel without frame.
    - a. Frame Finish: Black anodized.
  8. Tactile Letters: Raised 1/32 inch minimum.
  9. Braille: Grade II, ADA-compliant.

## 2.4 SIGNAGE APPLICATIONS

- A. Room and Door Signs:
  1. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section for replaceable occupant name.
  2. Conference and Meeting Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section with sliding "In Use/Vacant" indicator.
  3. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
  4. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.

## 2.5 ACCESSORIES

- A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.
- B. Tape Adhesive: Double-sided tape, permanent adhesive.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage ; repair or replace damaged items.

**END OF SECTION**



## SECTION 10 21 13.19 - PLASTIC TOILET COMPARTMENTS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Solid plastic urinal screens.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 10 28 00 - Toilet, Bath, and Laundry Accessories.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 3 by 3 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Bobrick; Duraline, Series 1082
- B. Solid Plastic Toilet Compartments:
  - 1. ASI Accurate Partitions: [www.asi-accuratepartitions.com/#sle](http://www.asi-accuratepartitions.com/#sle).
  - 2. ASI Global Partitions: [www.asi-globalpartitions.com/#sle](http://www.asi-globalpartitions.com/#sle).
  - 3. Substitutions: Section 01 25 00 - Substitution Procedures.

#### 2.2 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA 286; floor-mounted headrail-braced.
  - 1. Doors:
    - a. Thickness: 1 inch.
    - b. Width: 24 inch.
    - c. Width for Handicapped Use: 36 inch, out-swinging.
    - d. Height: 55 inch.
  - 2. Panels:
    - a. Thickness: 1 inch.
    - b. Height: 55 inch.

3. Pilasters:
  - a. Thickness: 1 inch.
  - b. Width: As required to fit space; minimum 3 inch.
4. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

## **2.3 ACCESSORIES**

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
- B. Head Rails: Extruded aluminum, anti-grip profile.
- C. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- D. Hinges: Stainless steel, manufacturer's standard finish.
  1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
- E. Door Hardware: Stainless steel, manufacturer's standard finish.
  1. Door Latch: Slide type with exterior emergency access feature.
- F. Coat Hook: One per compartment, mounted on door.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.

### **3.2 INSTALLATION**

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

### **3.3 TOLERANCES**

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

### **3.4 ADJUSTING**

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

**END OF SECTION**

## SECTION 10 26 00 - WALL AND DOOR PROTECTION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Corner guards.

#### 1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.

#### 1.3 REFERENCE STANDARDS

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
  - 1. Submit sections of corner guards, 24 inches long.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
  - 2. Extra Stock Materials: One package(s) of minimum 96 inches long unit of each kind of covers for corner guards.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

#### 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures or internal connection failures.
    - b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.
- C. Installer Warranty: Provide 5-year warranty for metal crash rails commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Corner Guards:
  - 1. Construction Specialties, Inc; Acrovyn Solid Color and Chameleon Crash Rails: [www.c-sgroup.com/#sle](http://www.c-sgroup.com/#sle).

2. Inpro: [www.inprocorp.com/#sle](http://www.inprocorp.com/#sle).
3. Koroseal Interior Products: [www.koroseal.com/#sle](http://www.koroseal.com/#sle).

## 2.2 PRODUCT TYPES

- A. Corner Guards - Flush Mounted:
  1. Material: Type 304 stainless steel, No. 4 finish.
  2. Width of Wings: 2 inches.
  3. Corner: Square.
  4. Color: As selected from manufacturer's standard colors.
  5. Length: One piece.
- B. Adhesives and Primers: As recommended by manufacturer.

## 2.3 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
  1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

### 3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position corner guard 4 inches above finished floor to ceiling.

### 3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

### 3.4 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

**END OF SECTION**



## SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Diaper changing stations.
- D. Utility room accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 30 00 - Tiling: Ceramic washroom accessories.
- B. Section 10 21 13.19 - Plastic Toilet Compartments.
- C. Section 22 40 00 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM C1036 - Standard Specification for Flat Glass.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.
- G. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Samples: Submit one samples of each accessory, illustrating color and finish.
- D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
  - 1. American Specialties, Inc: [www.americanspecialties.com/#sle](http://www.americanspecialties.com/#sle).
  - 2. Bradley Corporation: [www.bradleycorp.com/#sle](http://www.bradleycorp.com/#sle).
  - 3. Gamco; : [www.gamcousa.com](http://www.gamcousa.com)
  - 4. Bobrick Company; : [www.bobrick.com](http://www.bobrick.com)
  - 5. Substitutions: Section 01 25 00 - Substitution Procedures
- B. Diaper Changing Stations:
  - 1. Koala Kare Products: [www.koalabear.com/#sle](http://www.koalabear.com/#sle).
  - 2. Substitutions: Section 01 25 00 - Substitution Procedures
- C. Provide products of each category type by single manufacturer.

## 2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- G. Adhesive: Two component epoxy type, waterproof.
- H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

## 2.3 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- C. Powder-Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.
- D. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
- E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- F. Back paint components where contact is made with building finishes to prevent electrolysis.

## 2.4 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Surface mounted, for coreless type rolls.
  - 1. Products:
    - a. Owner Provided, Contractor Installed
- B. Paper Towel Dispenser: Folded paper type, stainless steel, fully-recessed, with continuous piano hinges and tumbler lock.
  - 1. Products:
    - a. Owner Provided, Contractor Installed.
- C. Waste Receptacle: Recessed, seamless lower door for access to container, with tumbler lock, reinforced panel full height of door, continuously welded bottom pan and seamless exposed flanges., stainless steel.
  - 1. Products:
    - a. Owner Provided, Contractor Installed.
- D. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
  - 1. Products:
    - a. Owner Provided, Contractor Installed.
- E. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
  - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.

2. Size: As indicated on drawings.
  3. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
  4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
  5. Fixed Tilt Mirrors: Minimum 3 inches tilt from top to bottom.
  6. Shelf: Stainless steel; gauge and finish to match mirror frame, turned down edges, welded to frame; 5 inches deep, full width of mirror.
  7. Products:
    - a. Bobrick Company; B290 24x36: [www.bobrick.com](http://www.bobrick.com)
    - b. Gamco; C-24x36: [www.gamcousa.com](http://www.gamcousa.com)
- F. Grab Bars: Stainless steel, smooth surface.
1. Standard Duty Grab Bars:
    - a. Push/Pull Point Load: 250 pound-force, minimum.
    - b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
    - c. Finish: Satin.
    - d. Length and Configuration:
      - 1) 18" Vertical
      - 2) 36" Horizontal
      - 3) 42" Horizontal
      - 4) 30" Horizontal
    - e. Location(s): As indicated on drawings.
    - f. Products:
      - 1) Bobrick Company; B-6806 Series: [www.bobrick.com](http://www.bobrick.com)
      - 2) Gamco; 150S Series: [www.gamcousa.com](http://www.gamcousa.com)
- G. Combination Sanitary Napkin/Tampon Dispenser with Disposal: Stainless steel, surface mounted.
1. Products:
    - a. Owner Provided, Contractor Installed.
- H. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted and back-to-back partition mounting with adjustable flanges, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
1. Products:
    - a. Owner Provided, Contractor Installed.

## 2.5 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1-1/4 inch outside diameter, 0.05 inch wall thickness, satin-finished, with 2 1/2 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
1. Products:
    - a. Bobrick Company; B-6047: [www.bobrick.com](http://www.bobrick.com)
    - b. Gamco; SR125SQ: [www.gamcousa.com](http://www.gamcousa.com)
- B. Shower Curtain:
1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
  2. Size: 42 by 72 inches, hemmed edges.
  3. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
  4. Color: White.
  5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
  6. Products:

- a. Bobrick Company; 204-2: www.bobrick.com
  - b. Gamco; 100SC: www.gamcousa.com
  - c. Substitutions: Section 01 25 00 - Substitution Procedures
- C. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

## 2.6 DIAPER CHANGING STATIONS

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
1. Material: Polyethylene.
  2. Mounting: Surface.
  3. Color: As selected.
  4. Minimum Rated Load: 250 pounds.
  5. Products:
    - a. Horizontal Baby Changing Table:
      - 1) Polyethylene Horizontal Design with molded Braille instructions KB300 by Koala, 961 or 9611 by Bradley, 9012 by ASI, Drybaby ABC-300H by World Dryer.
      - 2) Stainless-steel shell with polyethylene body. KB300-SS by Koala.
      - 3) Stainless Steel Recessed Mounted Horizontal Design KB310-SSRE by Koala, 9013 by ASI, ABC-300HSR by World Dryer
      - 4) Stainless Steel Surface Mounted Horizontal Design KB310-SSWM by Koala, 9013-9 by ASI, Drybaby ABC-300 HS

## 2.7 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
1. Drying rod: Stainless steel, 1/4 inch diameter.
  2. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
  3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
  4. Length: Manufacturer's standard length for number of holders/hooks.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.
- D. See Section 06 10 00 - Rough Carpentry for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

### 3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

### 3.3 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
- D. Drill Holes to correct size and application that is concealed by item, with 1/2" tolerance.
- E. Mount surface mounted accessories to back up with toggle bolts, plumb and aligned.
- F. Anchor grab bars to through-wall anchor plates.



### **3.4 PROTECTION**

- A. Protect installed accessories from damage due to subsequent construction operations.

### **3.5 ADJUSTING AND CLEANING**

- A. Adjust accessories for proper operation.
- B. After completion and installation, clean and polish all exposed surfaces.
- C. Deliver keys and instruction sheets to Owner.

**END OF SECTION**



## SECTION 10 43 00 - EMERGENCY AID SPECIALTIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Automated external defibrillators (AEDs).
- B. Automated external defibrillator (AED) cabinets.
- C. Accessories.

#### 1.2 DEFINITIONS

- A. Automated External Defibrillator (AED): A Food and Drug Administration (FDA)-approved portable device, which automatically analyzes the heart rhythm and recognizes the presence of ventricular fibrillation and/or tachycardia. If defibrillation is warranted, the AED automatically charges and prompts (visual and/or audio) the operator to deliver an electrical shock.

#### 1.3 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide AED operational features, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test schedules and recertification requirements.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Automated External Defibrillators (AEDs):
  - 1. Philips Medical Systems; HeartStart OnSite AED: [www.usa.philips.com/#sle](http://www.usa.philips.com/#sle).
  - 2. Stryker Corporation; LIFEPAK CR2 Defibrillator - LP-CR2: [www.stryker.com/#sle](http://www.stryker.com/#sle).
- B. Emergency Aid Cabinets and Accessories:
  - 1. Activar Construction Products Group, Inc. - JL Industries; LifeStart 1400 Series AED Cabinet: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
  - 2. Modern Metal Products, a division of Technico, Inc; 180 Series: [www.modern-metal.com/#sle](http://www.modern-metal.com/#sle).

#### 2.2 AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)

- A. Automated External Defibrillators (AEDs) - General: FDA approval required.
  - 1. Provide automated external defibrillators (AEDs) as indicated.

#### 2.3 EMERGENCY AID CABINETS

- A. Type: Automated external defibrillator (AED).
- B. Cabinet Construction: Non-fire-rated.
  - 1. Formed primed steel sheet; 0.036 inch thick base metal.
  - 2. Formed aluminum; 0.036 inch thick base metal.
- C. Fire-Rated Cabinet Construction: One-hour fire rated.
  - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- D. Cabinet Configuration: Surface mounted type.
  - 1. Size to accommodate AED.

- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with wire pull handle and nylon catch. Hinge door for 180 degree opening with two butt hinges.
- F. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- G. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- H. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.
- I. Fabrication: Weld, fill, and grind components smooth.
- J. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- K. Finish of Door Pull or Handle: Stainless steel.
- L. Finish of Cabinet Interior: White powder coat.

## **2.4 ACCESSORIES**

- A. Theft Alarm: Battery operated audible and strobe light alarm, 10 second delay for disarming, activated by opening cabinet door. Alarm deactivated when door is closed.
- B. Alarm Contacts: Contact devices.
  - 1. Magnetic door contact for existing alarm systems.
- C. Cabinet Door Signage: 'AED" decal, or vinyl self-adhering, prespaced black lettering and identifying graphic in accordance with authorities having jurisdiction (AHJ).
- D. Plastic Wall Signage: Flat style.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 3' - 10" inches from finished floor to center of operation.
- C. Secure rigidly in place.
- D. Place AEDs in cabinets.
- E. Wall Signs:
  - 1. Location: Where shown.
- F. Cabinet Lettering:
  - 1. Location: Face of door framing.

### **3.3 ADJUSTING AND CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust cabinet doors to operate smoothly without binding. Verify that alarms and integral locking devices operate properly.
- C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes. Replace cabinets that cannot be restored to factory-finished appearance. Use materials and procedures recommended by cabinet manufacturer.

### **3.4 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals for closeout submittals.





- B. See Section 01 79 00 - Demonstration and Training for additional requirements.  
**END OF SECTION**



## SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Key Box.
- D. Accessories.

#### 1.2 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

#### 1.4 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Fire Extinguishers:
  - 1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
- B. Fire Extinguisher Cabinets and Accessories:
  - 1. Activar Construction Products Group, Inc. - JL Industries; Embassy Series: [www.activarcpg.com/#sle](http://www.activarcpg.com/#sle).
  - 2. Larsen's Manufacturing Co; O-2409 Occult Series: [www.larsensmfg.com/#sle](http://www.larsensmfg.com/#sle).
  - 3. Nystrom, Inc; Summit Fire Extinguisher Cabinet: [www.nystrom.com/#sle](http://www.nystrom.com/#sle).
  - 4. Potter-Roemer; Dana Fire Extinguisher Cabinet: [www.potterroemer.com/#sle](http://www.potterroemer.com/#sle).

#### 2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
  - 1. Class: A:B:C type.
  - 2. Size: 10 pound.
  - 3. Finish: Baked polyester powder coat, color as selected.
  - 4. Temperature range: Minus 40 degrees F to 120 degrees F.

#### 2.3 FIRE EXTINGUISHER CABINETS

- A. Cabinet Configuration: Recessed type.
  - 1. Size to accommodate accessories.
- B. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- C. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- D. Finish of Cabinet Interior: White colored enamel.



## **2.4 KEY BOX**

- A. Knox-Box 3200 Series with hinged door, Recessed Model #3275, with alarm tamper switch as manufactured by Knox Company, Knox Rapid Entry System. Color shall be dark bronze .

## **2.5 ACCESSORIES**

- A. Extinguisher Brackets: Formed steel, chrome-plated.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify rough openings for cabinet are correctly sized and located.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.

**END OF SECTION**

## SECTION 10 51 13 - METAL LOCKERS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Metal lockers.
- B. Locker benches.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base construction.
- B. Section 06 10 00 - Rough Carpentry: Wood base construction.
- C. Section 06 10 00 - Rough Carpentry: Wood blocking and nailers.
- D. Section 06 20 00 - Finish Carpentry: Bench tops for locker bench support brackets.

#### 1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
- D. Samples: Submit two samples 3 by 6 inches in size showing color and finish of metal locker material.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Metal Lockers:
  - 1. Art Metal Products: [www.artmetalproducts.com/#sle](http://www.artmetalproducts.com/#sle).
  - 2. ASI Storage Solutions: [www.asi-storage.com/#sle](http://www.asi-storage.com/#sle).
  - 3. List Industries, Inc: [www.listindustries.com/#sle](http://www.listindustries.com/#sle).
  - 4. Lyon Workspace Products: [www.lyonworkspace.com/#sle](http://www.lyonworkspace.com/#sle).
  - 5. Republic Storage Systems Co: [www.republicstorage.com/#sle](http://www.republicstorage.com/#sle).

#### 2.2 LOCKER APPLICATIONS

- A. Athletic Lockers: Metal lockers, wall mounted with matching closed base.
  - 1. Width: 12 inch.
  - 2. Depth: 12 inches.
  - 3. Height: 60 inches.
  - 4. Configuration: Two tier.
  - 5. Fittings: Size and configuration as indicated on drawings.
    - a. Upper shelf.
    - b. Hooks: One double prong.
  - 6. Ventilation: Perforated side panels and doors.
  - 7. Locking: Built-in combination locks.
  - 8. Provide sloped top.
  - 9. Color: To be selected from manufacturer's full range by Architect.
- B. Open-Front Turnout Gear Lockers: Metal lockers, free-standing.
  - 1. Width: 18 inches.

2. Depth: 12 inches.
3. Height: 84 inches.
4. Configuration: Single tier.
5. Fittings: Size and configuration as indicated on drawings.
  - a. Upper shelf.
  - b. Hooks: Four double prong.
6. Ventilation: Perforated side panels, doors, and back panels.
7. Door Configuration: Pair, solid with standard horizontal louvers top and bottom.
8. Color: To be selected from manufacturer's full range by Architect.

### **2.3 METAL LOCKERS**

- A. Locker Case Construction:
  1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
- B. Latches and Door Handles: Manufacturer's standard.
- C. Sloped Top: 20 gauge, 0.0359 inch, with closed ends.
- D. Coat Hooks: Stainless steel or zinc-plated steel.
- E. Locks: Locker manufacturer's standard type indicated in Applications article above.

### **2.4 LOCKER BENCHES**

- A. Locker Benches: Free standing type; bench top of laminated birch; painted steel pedestals.
  1. Accessibility: Comply with ICC A117.1 and ADA Standards.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that prepared bases are in correct position and configuration.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Install fittings if not factory installed.
- E. Replace components that do not operate smoothly.

### **3.3 CLEANING**

- A. Clean locker interiors and exterior surfaces.

**END OF SECTION**

## SECTION 12 32 00 - MANUFACTURED WOOD CASEWORK

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Manufactured standard and custom casework, with cabinet hardware.
- B. Countertops.

#### 1.2 RELATED REQUIREMENTS

- A. Section 12 36 00 - Countertops: Additional requirements for countertops.

#### 1.3 DEFINITIONS

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

#### 1.4 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.
- C. BHMA A156.9 - Cabinet Hardware.
- D. NEMA LD 3 - High-Pressure Decorative Laminates.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Component dimensions, configurations, construction details, joint details, attachments.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.
- D. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- E. Finish touch-up kit for each type and color of materials provided.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:

1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

## 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
  1. Ruptured, cracked, or stained finish coating.
  2. Discoloration or lack of finish integrity.
  3. Cracking or peeling of finish.
  4. Delamination of components.
  5. Failure of adhesives.
  6. Failure of hardware.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Plastic Laminate Casework:
  1. Case Systems: [www.casesystems.com/#sle](http://www.casesystems.com/#sle).
  2. Diversified Fixture: [www.diversifiedfixture.com/#sle](http://www.diversifiedfixture.com/#sle).
- B. Obtain casework from single source and manufacturer, unless otherwise indicated.

### 2.2 CASEWORK, GENERAL

- A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom Grade.

### 2.3 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Construction: As required for selected grade.
- C. Structural Performance: Safely support the following minimum loads:
  1. Base Units: 500 pounds per linear foot across the cabinet ends.
  2. Drawers: 125 pounds, minimum.
  3. Hanging Wall Cases: 300 pounds.
  4. Shelves: 100 pounds, minimum.
- D. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.
- E. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
- F. Fixed panels at backs of open spaces between base cabinets.
- G. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- H. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
- I. Apron Frames: Construction similar to other cabinets, with modifications.



1. Frames fabricated from panels standard with the manufacturer. Include front and back panels, with drawer suspension framing mechanically fastened to support channels spanning between them.
- J. Countertop Panel-Type Supports: Materials similar to adjacent casework, 1-1/2 inch in width, with front-to-back and toe space dimensions matching base cabinet. Designed to be secured in a concealed fashion to countertop material. Include two leveling devices per support panel.

## 2.4 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
  1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
  2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
    - a. Base Cabinets: 24 inches.
    - b. Tall Cabinets: 22 inches.
    - c. Wall Cabinets: 16 inches.
  3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
    - a. Finish: As indicated on drawings..
    - b. Surface Color and Pattern: As indicated on drawings.
    - c. Exposed Interior Surfaces: Thermally fused laminate.
      - 1) Color: White.
    - d. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
    - e. Cap exposed plastic laminate finish edges with material of same finish and pattern.

## 2.5 COUNTERTOPS

- A. Countertops: See Section 12 36 00.

## 2.6 CABINET HARDWARE

- A. Manufacturer's standard types, styles and finishes.
- B. Comply with BHMA A156.9 requirements.
  1. Acceptable base materials for plated finishes include steel.
- C. Shelves in Cabinets:
  1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- D. Swinging Doors: Hinges, pulls, and catches.
  1. Hinges: Concealed, number as required by referenced standards for width, height, and weight of door.
    - a. Visible Hinges: Installed on framed cabinet face, and on door face, bright chromium plated over nickel on base material.
    - b. Concealed Hinges: Installed in cabinet edge, and on door back, bright chromium plated over nickel on base material.
  2. Pulls: Chrome decorative design, 4 inches wide.
    - a. Pull design to comply with project's referenced accessibility requirements.
  3. Catches: Magnetic.
- E. Drawers: Pulls and slides.
  1. Pulls: Chrome decorative design, 4 inches wide.
    - a. Pull design to comply with project's referenced accessibility requirements.
  2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

## 2.7 MATERIALS

- A. Wood-Based Materials:
  - 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications. complying with Grade requirements, and standard with the manufacturer.

## 2.8 ACCESSORIES

- A. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
  - 1. Color: As selected by Architect from manufacturer's standard range.
  - 2. Use at exposed edges.
  - 3. Use at exposed shelf edges.
- B. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- C. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.
- D. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.
- E. Sealant for Use in Casework Installation:
  - 1. Manufacturer's recommended type.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

### 3.2 EXAMINATION

- A. Site Verification of Environmental Conditions:
  - 1. Do not deliver casework until the following conditions have been met:
    - a. Building has been enclosed (windows and doors sealed and weather-tight).
    - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
    - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
    - d. Installation areas do not require further "wet work" construction.
- B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
- C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
  - 1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
  - 2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.
- D. Verify adequacy of support framing and anchors.
- E. Verify that service connections are correctly located and of proper characteristics.

### 3.3 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.

- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
  - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
  - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
  - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
  - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.
- G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches on center.
- I. Install hardware uniformly and precisely.
- J. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- K. Replace units that are damaged, including those that have damaged finishes.

### **3.4 ADJUSTING**

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

### **3.5 CLEANING**

- A. Clean casework and other installed surfaces thoroughly.

### **3.6 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

**END OF SECTION**



## SECTION 12 36 00 - COUNTERTOPS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.

#### 1.2 RELATED REQUIREMENTS

- A. Section 12 32 00 - Manufactured Wood Casework.

#### 1.3 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.
- B. AWI (QCP) - Quality Certification Program.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition.
- D. AWMAC (GIS) - Guarantee and Inspection Services Program.
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.
- F. ISFA 2-01 - Classification and Standards for Solid Surfacing Material.
- G. NEMA LD 3 - High-Pressure Decorative Laminates.
- H. WI (CCP) - Certified Compliance Program (CCP).

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. NSI Fabricator Qualification: Documentation of Natural Stone Institute Accreditation.
- G. Installer's qualification statement.

#### 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Natural Stone Institute (NSI) Accredited Natural Stone Fabricator; [www.naturalstoneinstitute.org/#sle](http://www.naturalstoneinstitute.org/#sle).
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- C. Quality Certification:
  - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.awiqcp.org/#sle](http://www.awiqcp.org/#sle).
  - 2. Comply with AWMAC (GIS) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
  - 3. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: [www.woodworkinstitute.com/#sle](http://www.woodworkinstitute.com/#sle).

4. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
5. Provide designated labels on shop drawings as required by certification program.
6. Provide designated labels on installed products as required by certification program.
7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

## 1.7 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## PART 2 PRODUCTS

### 2.1 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
  1. Laminate Sheet PL2/PL5: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
    - a. Manufacturers:
      - 1) Wilsonart: [www.wilsonart.com/#sle](http://www.wilsonart.com/#sle).
    - b. Wear Resistance: In addition to specified grade, comply with NEMA LD 3 High Wear Grade requirements for wear resistance.
    - c. Finish: As indicated on drawings.
    - d. Surface Color and Pattern: As indicated on drawings.
  2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
  3. Back and End Splashes: Same material, same construction.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
  1. Flat Sheet Thickness: 1/2 inch, minimum.
  2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Manufacturers:
      - 1) Durat.
    - b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
    - c. Color and Pattern: As indicated on drawings.
  3. Other Components Thickness: 1/2 inch, minimum.
  4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
  5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
  6. Fabricate in accordance with manufacturer's standard requirements.

### 2.2 MATERIALS

- A. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

- B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- C. Joint Sealant: Mildew-resistant silicone sealant, white.

### 2.3 ACCESSORIES

- A. Fixed Top-Mounted Countertop Support Brackets:
  - 1. Finish: Manufacturer's standard, factory-applied, textured powder coat.
  - 2. Color: White.
  - 3. Products:
    - a. Centerline Brackets; Front Mounting Countertop Support:  
[www.countertopbracket.com/#sle](http://www.countertopbracket.com/#sle).

### 2.4 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
  - 1. Join lengths of tops using best method recommended by manufacturer.
  - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
  - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
  - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
  - 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
- C. Seal joint between back/end splashes and vertical surfaces.

### 3.4 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.



**3.5 CLEANING**

**3.6 PROTECTION**

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

**END OF SECTION**



## SECTION 12 66 13 - TELESCOPING BLEACHERS

### PART 2 PRODUCTS

#### 1.1 TELESCOPING BLEACHERS

- A. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.
1. Design to comply with applicable requirements of NFPA 102 and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
  2. Design with solid fascia (riser) or seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
  3. Operation: Motor operated.
- B. Design Loads: Design to withstand the following loading conditions:
1. Live Load on Structural Supports: 100 psf, minimum, of gross horizontal projection.
  2. Live Load on Seats and Walking Surfaces: 120 pounds per linear foot.
  3. Lateral Sway Stress on Structural Supports: 24 pounds per linear foot of seat plank.
  4. Perpendicular Sway Stress on Structural Supports: 10 pounds per linear foot of seat plank.
- C. Dimensions:
1. Rows: Twelve.
  2. Rise Per Row: 10 inches.
  3. Row Depth: 22 inches.
  4. Seat Height Above Tread: 6 inches.
- D. Structural Supports: Steel or aluminum; manufacturer's standard wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.
1. Design so that each row carriage so that it will individually support the design loads and is self supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
  2. Welding: In accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
  3. Bolting: Use lock-washers or locknuts.
  4. Wheels: Minimum 5 inch diameter by 1-1/8 inch wide, with non-marring rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
  5. Finish: Manufacturer's standard enamel or powder coating.
  6. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
  7. Unlocking: Automatically unlock all rows before engaging retraction mechanism.
- E. Motor Operation: Manufacturer's standard drive mechanism, using motor adequately sized for the purpose.
1. Provide UL listed electrical components and wiring.
  2. Controls: Start, Stop, Forward, and Reverse in a single control unit.
  3. Control Station: Removable plug-in low-voltage pendant station, with first-row plug-in location for each motor.
  4. Limit Switches: Automatically stop operation when unit has reached fully open or fully closed position.
  5. Provide all wiring internal to bleacher units, to junction box located where indicated; ensure that wiring is not energized except during operation.
  6. Electrical Characteristics: 120V, single phase, 60 Hz.



7. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least 30 inches wide is acceptable.

**END OF SECTION**

## SECTION 14 42 00 - WHEELCHAIR LIFTS

### PART 1 GENERAL

#### 1.1 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections.
- B. Section 26 27 26 - Wiring Devices.

#### 1.2 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices.
- D. ASME A18.1 - Safety Standard for Platform Lifts and Stairway Chairlifts.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM A786/A786M - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- J. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- L. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities.
- N. ITS (DIR) - Directory of Listed Products.
- O. NEMA MG 1 - Motors and Generators.
- P. NFPA 70 - National Electrical Code.
- Q. UL (DIR) - Online Certifications Directory.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate installation of wheelchair lift system with adjacent construction using necessary attachments; provide anchoring devices in accordance with manufacturer's installation instructions; coordinate installation of cast-in-place concrete components.
  - 1. Electrical System: Coordinate utility and electrical system connections to ensure they are made in an orderly and expeditious manner.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Include data on material descriptions, construction details, component dimensions and profiles, and finishes; include data on rated capacities, electrical and operating characteristics, and necessary accessories.

- C. Shop Drawings: Include plans, elevations, sections, and attachment details; include equipment assembly details with dimensions, weights, loads, required clearances, components, size and location of anchors and required field connections, and methods for field assembly; provide diagrams indicating signal, power, and control wiring.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.
- F. Executed warranty.
- G. Project Record Documents: Accurately record actual locations of concealed items, conduits, and components.
- H. Maintenance Materials: Provide the following for Owner's use in maintenance of wheelchair lifts and equipment.
  - 1. See Section 01 60 00 - Product Requirements for additional provisions.
  - 2. Provide technical information for servicing operating equipment.
  - 3. Spare Parts: Provide parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
  - 4. Provide legible schematic wiring diagrams of installed electrical equipment and changes made to this part of work; list symbols corresponding to identity or markings on wheelchair lifts structural and electrical components.

## 1.5 QUALITY ASSURANCE

### 1.6 FIELD CONDITIONS

- A. Use of wheelchair lifts during construction for hoisting materials or personnel is not permitted.

### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty to repair or replace wheelchair lift system components that fail in materials or workmanship. Complete forms in Owner's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A18.1, ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
- B. Accessibility Requirements: Comply with ADA Standards and ICC A117.1.
- C. Structural Performance: Comply with ASCE 7 for loading of wheelchair lift components and assemblies.
- D. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- E. Perform electrical work in accordance with NFPA 70.

### 2.2 INCLINED PLATFORM WHEELCHAIR LIFTS

- A. Manufacturers:
  - 1. Garaventa Lift; Artira - Inclined Platform Lift for Straight and Turning Stairways: [www.garaventalift.com/#sle](http://www.garaventalift.com/#sle).
- B. Inclined Platform Wheelchair Lifts: Provide manufacturer's standard type that complies with indicated requirements. Use manufacturer's standard components for inclined platform wheelchair lifts as required for complete system unless otherwise indicated.
  - 1. Number of Landings: As indicated on drawings.
  - 2. Type:

- a. Indoor stairway, with straight or turning inclined platform wheelchair lift, having landings at top and bottom, with factory fabricated extruded aluminum guide rail, folding platform that moves along guide rail using rope sprocket drive system, with overspeed safety system, and call stations at each landing.
3. Configuration:
  - a. Inclined lift on straight stairway with intermediate horizontal landing.
4. Location:
  - a. Interior of building, as indicated on drawings.
5. Lift Load Capacity: 660 lb, maximum.
6. Rated Speed:
  - a. Traveling Upward: 20 fpm, nominal.
  - b. Traveling Downward: 20 fpm, nominal.
  - c. Traveling Through Turn: 10 fpm, nominal.
7. Platform Width: 31-1/2 inches, ADA compliant, nominal.
8. Platform Length: 48 inches, ADA compliant, nominal.
9. Provide fold-down seat with seatbelt mounted to platform wall panel in accordance with ASME A18.1.
10. Platform Operation:
  - a. Automatic Fold: Platform folds to ensure stairway is clear when left unattended for a designated time.
  - b. Emergency Manual Fold: When platform is left in an open position, it may be manually folded and retained in a closed position.
11. Drive Operation:
  - a. Motor: Electric motor with integrated brake, providing power transmission using roped sprocket drive system having a motor, gearbox, and programmable configuration controller-PCC at upper end of guide rail metal tubes.

## 2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics:
  1. 2 hp.
  2. 20 rated load amperes.
  3. 208 to 240 VAC, single-phase, 60 Hz.
  4. System wiring connections; see Section 26 05 83.
  5. System wiring devices; see Section 26 27 26.
- B. Platform Controls: Continuous pressure switch, one for each direction, with keyless operation.
- C. Attendant: Provide call device at each landing to contact attendant, if necessary.
- D. Geared Motor: Comply with NEMA MG 1.
- E. Disconnect Switch: Factory mount disconnect switch in control panel.
- F. Emergency Operation: Provide manual operation, battery-powered system, and connection to standby electrical power to raise or lower lift to landing due to malfunction or loss of power.
- G. Electrical Components, Boxes, Conduit, Wiring, and Devices: Comply with NFPA 70 and UL (DIR) or ITS (DIR) listed and labeled, and marked as applicable for proposed locations.

## 2.4 MATERIALS

- A. Rolled Steel Sections, Shapes, and Rods: Comply with ASTM A36/A36M.
- B. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.
- C. Rolled Steel Floor Plates: Comply with ASTM A786/A786M, 1/8 inch thick, with manufacturer's standard surface pattern; rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
- D. Steel Tubing: Comply with ASTM A500/A500M, cold formed.

- E. Anchor Bolts and Rods: Comply with ASTM F1554, Grade 55.
- F. Welding: Comply with applicable requirements of AWS D1.1/D1.1M and AWS D1.3/D1.3M.

## **2.5 EQUIPMENT**

- A. Lubrication of Equipment: Provide grease fittings for lubricating bearings requiring periodic lubrication, automatic feed type grease cups, and visible and easily accessible lubrication points.
- B. Guide Rails, Ropes, Counterweights, Sheaves, Attachment Brackets, and Anchors: Sized in accordance with local building code, including safety factors.
- C. Maintenance Devices: Provide as necessary within wheelchair lift system, supported on structural members within accessible locations.

## **2.6 FINISHES**

- A. Baked-On Factory Finish for Structural Metal Surfaces: Clean surfaces of rust, oil, or grease and wipe clean with solvent; apply manufacturer's standard two-coat, baked-on finish consisting of primer and thermosetting top coat.
  - 1. Color: Manufacturer's standard color.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that areas and conditions comply with installation tolerances and other conditions affecting this work.
- B. Verify that locations for electrical rough-in connections to system equipment are in acceptable locations before installing equipment.
- C. Verify that electrical power is available and of correct characteristics.
- D. Do not proceed with installation until unacceptable conditions have been corrected.

### **3.2 PREPARATION**

- A. Prepare surfaces of substrates using methods in accordance with lift manufacturer's installation instructions.
- B. Clean surfaces thoroughly before starting installation of lifts.

### **3.3 INSTALLATION**

- A. Install wheelchair lift system and components in accordance with manufacturer's written installation instructions.
- B. Install wheelchair lift system securely to supporting structure, and flush with adjacent surfaces.
- C. Install structural components using methods that comply with requirements indicated relative to layout and structural position.

### **3.4 ADJUSTING**

- A. Adjust wheelchair lift equipment to operate smoothly and safely.
- B. Verify vertical travel of wheelchair lift system; adjust as necessary to maintain operating range indicated.
- C. After installation, inspect exposed factory-finished wheelchair lift equipment and repair damaged finishes.

### **3.5 CLEANING**

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove protective coverings from finished surfaces.
- C. Clean surfaces and components.



### **3.6 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training for additional requirements.
- C. Demonstrate proper operation of wheelchair lifts to Owner's designated representative.
- D. Demonstration: Demonstrate operation of wheelchair lift system to Owner's personnel.
  - 1. Use operation and maintenance data as a reference during the demonstration.
  - 2. Briefly describe function, operation, and maintenance of each component.

### **3.7 MAINTENANCE**

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Perform maintenance work using competent personnel under supervision and in direct employment of wheelchair lift installer.
- C. Examine monthly; clean, adjust, and lubricate equipment.
- D. Repair, or replace parts when required with parts produced by original equipment manufacturer.

**END OF SECTION**





## SECTION 22 05 00 - PLUMBING SUMMARY OF WORK

### PART 1 - GENERAL

#### PRODUCTS (NOT APPLICABLE)

### PART 3 - EXECUTION

#### 3.1 SUMMARY OF WORK

- A. The Summary of work is provided as a condensed description of the work and does not relieve the contractor from compliance with the complete set of documents, including the project specifications manual and complete drawing set. (Refer to Table of Contents.)
- B. Contractor shall provide all labor, materials, equipment, Plumbing permits, inspection fees, re-inspection fees (if necessary), supervision, and other items noted in contract General Conditions necessary to yield completely operable and tested systems as specified, as indicated on the Plans, and the following:
  1. Coordination of all work with job site superintendent and all applicable trades. The Contractor shall assist in the field layout and coordination of equipment and piping installation and their relation with other trades at no additional cost to the Owner.
  2. Coordination of work with all site utilities.
  3. Coordination of work with water purveyor.
  4. Compliance with the requirements of each individual specification section listed in the table of contents to ensure complete, and operable systems as described therein.
  5. Drawing Plans, Schematics, and Diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and other design considerations. Install piping as indicated unless deviations to layout are minor or are pre-approved on coordination drawings.
  6. Access doors as required for valves and accessories.
  7. Final piping connections to equipment furnished by others.
  8. Painting:
    - a. Painting of exterior above ground piping as described in the applicable specification sections.
    - b. Touch-up painting of damaged materials furnished by this contractor and damaged prior to Owner occupancy. All materials shall match original color and finishes. All work shall be done by experienced field tradesmen.
  9. Protection of new and existing finishes and surfaces: Protect finished surfaces from damage due to demolition and new construction, including, but not limited to the following: Walls, floors, ceilings and roof.
  10. Flushing, cleaning, and testing of new and modified piping systems. Copies of all test reports shall be submitted to the Architect/Engineer as they are performed and approved by the Code Official for record purposes.
  11. Cleanup associated with work of respective trades.
  12. Provide as-built drawings at the completion of work.
  13. Operation and Maintenance manuals.
  14. All domestic water piping and components shall be in compliance with NSF/ANSI 372 "Drinking Water Systems Components – Lead Content" and the United States Safe Drinking Water Act (SDWA).
  15. Provide minimum one (1) year warranty against defects for materials and installation, unless otherwise indicated.
  16. Owner training in the operation and maintenance of installed equipment and systems. Using the Operating and Maintenance manuals, balancing report data, and contract drawings and specifications, the contractor shall instruct the Owner's representative(s) in the proper operation and maintenance of the equipment and systems installed to their mutual satisfaction. This activity shall take place near the point of substantial completion and will be considered a punch list item.



17. Demonstration: Provide Owner training as described in the applicable specification sections.
18. Job site safety is the responsibility of the contractor. The Architect/Engineer bears no responsibility for job-site safety.

**END OF SECTION**

## SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 22 05 23 - General-Duty Valves for Plumbing Piping.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Piping identification.
- D. Section 22 07 19 - Plumbing Piping Insulation.

#### 1.3 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.1 PIPE SLEEVES

- A. Manufacturers:
  - 1. Advance Products & Systems, LLC.
  - 2. Flexicraft Industries.
- B. Vertical Piping:
  - 1. Sleeve Length: 1 inch above finished floor.
  - 2. Provide sealant for watertight joint.
  - 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
  - 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

- C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. Pipe Passing Through Below Grade Exterior Walls:
  - 1. Zinc coated or cast iron pipe.
  - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Pipe Passing Through Mechanical Floors above grade:
  - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
  - 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Clearances:
  - 1. Provide allowance for insulated piping.
  - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
  - 3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

## 2.2 PIPE-SLEEVE SEALS

- A. Manufacturers:
  - 1. Advance Products & Systems, LLC.
  - 2. American Polywater Corporation.
  - 3. Flexicraft Industries.
  - 4. Garlock; Link-Seal.
- B. Modular Mechanical Sleeve-Seal:
  - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
  - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
  - 3. Size and select seal component materials in accordance with service requirements.
  - 4. Service Requirements:
    - a. Corrosion resistant.
    - b. Oil, fuel, gas, and solvent resistant.
    - c. Underground, buried, and wet conditions.
    - d. High Temperature, up to 250 degrees F.
    - e. Low temperature, down to minus 40 degrees F.
  - 5. Glass reinforced nylon polymer plastic pressure end plates.
  - 6. Type 316 stainless steel bolts and nuts.
  - 7. Nitrile seal elements.
- C. Sealing Compounds:
  - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
  - 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
- D. Pipe Sleeve Material:
  - 1. Bearing Walls: Steel, cast iron, or terracotta pipe.
  - 2. Masonry Structures: Sheet metal or fiber.
- E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

### 3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 3. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations: Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  - 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
  - 2. Aboveground Piping:
    - a. Pack solid using mineral fiber complying with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
  - 3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
  - 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
  - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  - 3. Locate piping in center of sleeve or penetration.
  - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  - 5. Tighten bolting for a water-tight seal.
  - 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.3 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION**



## SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Ball valves.
- B. Butterfly valves.
- C. Check valves.
- D. Chainwheels.

#### 1.2 RELATED REQUIREMENTS

- A. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

#### 1.3 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

#### 1.4 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End.
- G. ASME B31.9 - Building Services Piping.
- H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.
- I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- J. ASTM A536 - Standard Specification for Ductile Iron Castings.
- K. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
- L. AWWA C606 - Grooved and Shouldered Joints.
- M. MSS SP-67 - Butterfly Valves.
- N. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- O. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves.
- P. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- Q. NSF 61 - Drinking Water System Components - Health Effects.

- R. NSF 372 - Drinking Water System Components - Lead Content.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
  - 2. Protect valve parts exposed to piped medium against rust and corrosion.
  - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
  - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
  - 5. Secure check valves in either the closed position or open position.
  - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

## 1.8 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

## PART 2 PRODUCTS

### 2.1 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
  - 1. Shutoff: Ball.
  - 2. Throttling: Provide globe, ball, or butterfly.
  - 3. Swing Check (Pump Outlet):
    - a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    - b. 2-1/2 inch and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.



- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Required Valve End Connections for Non-Wafer Types:
  - 1. Copper Tube:
    - a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
    - b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
    - c. 5 inch and Larger: Grooved or flanged ends.
- F. Domestic, Hot and Cold Water Valves:
  - 1. 2 inch and Smaller:
    - a. Bronze and Brass: Provide with solder-joint or threaded ends.
    - b. Ball: Two piece, full port, brass with brass trim.
    - c. Bronze Swing Check: Class 125, bronze disc.
    - d. Bronze Gate: Class 125, NRS.
  - 2. 2-1/2 inch and Larger:
    - a. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
    - b. Iron Swing Check: Class 125, metal seats.

## 2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
  - 1. Gear Actuator: Quarter-turn valves 8 inch and larger.
  - 2. Handwheel: Valves other than quarter-turn types.
  - 3. Hand Lever: Quarter-turn valves 6 inch and smaller except plug valves.
  - 4. Wrench: Plug valves with square heads.
  - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
  - 1. Gate Valves: Rising stem.
  - 2. Ball Valves: 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: Extended neck.
  - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
  - 1. Threaded End Valves: ASME B1.20.1.
  - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
  - 3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
  - 4. Solder Joint Connections: ASME B16.18.
  - 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
  - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
  - 2. Solder-joint Connections: ASME B16.18.
  - 3. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
  - 1. Certified: Approved for use in compliance with NSF 61 and NSF 372.

2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Source Limitations: Obtain each valve type from a single manufacturer.

### **2.3 BRASS, BALL VALVES**

A. Two Piece, Full Port with Brass Trim and Female Thread, Male thread, or Solder Connections:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged brass.
5. Seats: PTFE.
6. Blow-out Proof Stem: Brass.
7. Ball: Chrome-plated brass.
8. Operator: Lever handle and stem extension.
9. Manufacturers:
  - a. American Valve.
  - b. Aalberts integrated piping systems; Apollo Valves.
  - c. Crane ChemPharma & Energy; Jenkins Valves.
  - d. Crane ChemPharma & Energy; Stockham Division.
  - e. Hammond Valve.
  - f. Jomar Valve.
  - g. Legend Valve & Fitting Inc.
  - h. Milwaukee Valve Corporation.
  - i. NIBCO Inc.
  - j. Red-White Valve Corp.

B. Two Piece, Full Port with Press Connections:

1. WOG Rating: 250 psi.
2. Body: Forged brass.
3. Seats: EPDM.
4. Ball: Chrome-plated brass.
5. Blow-out Proof Stem: Forged brass.
6. Operator: Provide stem extension and lever handle.
7. Maximum Service Temperature: 250 degrees F.
8. Manufacturers:
  - a. American Valve.
  - b. Aalberts integrated piping systems; Apollo Valves.
  - c. Crane ChemPharma & Energy; Jenkins Valves.
  - d. Crane ChemPharma & Energy; Stockham Division.
  - e. Hammond Valve.
  - f. Jomar Valve.
  - g. Legend Valve & Fitting Inc.
  - h. Milwaukee Valve Corporation.
  - i. NIBCO Inc.
  - j. Red-White Valve Corp.
  - k. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.4 BRONZE, BALL VALVES**

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.

2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Bronze, blowout proof.
8. Ball: Chrome plated brass.
9. Operator: Provide stem extension and lever handle.
10. Manufacturers:
  - a. American Valve.
  - b. Aalberts integrated piping systems; Apollo Valves.
  - c. Crane ChemPharma & Energy; Jenkins Valves.
  - d. Crane ChemPharma & Energy; Stockham Division.
  - e. Hammond Valve.
  - f. Jomar Valve.
  - g. Legend Valve & Fitting Inc.
  - h. Milwaukee Valve Corporation.
  - i. NIBCO Inc.
  - j. Red-White Valve Corp.
  - k. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.5 IRON, SINGLE FLANGE BUTTERFLY VALVES**

- A. Lug Style; Bi-directional dead-end service without use of downstream flange:
  1. Class 125, or Class 150 flanges.
  2. Comply with MSS SP-67, Type I.
  3. Lug Style, Service Pressure Ratings:
    - a. 150 psi for sizes 14 to 24 inch.
    - b. Vacuum down to 29.9 in-Hg.
  4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
  5. Stem: One or two-piece stainless steel.
  6. Seat: EPDM.
  7. Disc: Aluminum-bronze.
  8. Finish: Epoxy coated.
  9. Operator: Lockable handle over direct-mount actuator base.
  10. Manufacturers:
    - a. Aalberts integrated piping systems; Apollo Valves.
    - b. Crane ChemPharma & Energy; Jenkins Valves.
    - c. Crane ChemPharma & Energy; Stockham Division.
    - d. Jomar Valve.
    - e. Legend Valve & Fitting Inc.
    - f. Milwaukee Valve Corporation.
    - g. NIBCO Inc.
    - h. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.6 BRONZE, SWING CHECK VALVES**

- A. General:
  1. Fabricate from dezincification resistant material.
  2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
  1. Pressure and Temperature Rating: MSS SP-80, Type 3.
  2. Design: Y-pattern, horizontal or vertical flow.
  3. WOG Rating: 200 psi.
  4. Body: Bronze, ASTM B62.

5. End Connections: Threaded or soldered.
  6. Disc: Bronze.
  7. Manufacturers:
    - a. Aalberts integrated piping systems; Apollo Valves.
    - b. Crane ChemPharma & Energy; Jenkins Valves.
    - c. Crane ChemPharma & Energy; Stockham Division.
    - d. Hammond Valve.
    - e. Jomar Valve.
    - f. Legend Valve & Fitting Inc.
    - g. Milwaukee Valve Corporation.
    - h. NIBCO Inc.
    - i. Red-White Valve Corp.
    - j. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Class 150:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
  2. Design: Y-pattern, horizontal or vertical flow.
  3. WSP Rating: 150 psi.
  4. WOG Rating: 300 psi.
  5. Body: Bronze, ASTM B62.
  6. End Connections: Threaded or soldered.
  7. Disc: Bronze.
  8. Manufacturers:
    - a. Aalberts integrated piping systems; Apollo Valves.
    - b. Crane ChemPharma & Energy; Jenkins Valves.
    - c. Crane ChemPharma & Energy; Stockham Division.
    - d. Hammond Valve.
    - e. Jomar Valve.
    - f. Legend Valve & Fitting Inc.
    - g. Milwaukee Valve Corporation.
    - h. NIBCO Inc.
    - i. Red-White Valve Corp.
    - j. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.7 IRON, HORIZONTAL SWING CHECK VALVES

- A. Class 125:
1. Pressure and Temperature Rating: MSS SP-71, Type I.
  2. Design: T-body style for clear or full waterways.
  3. WOG Rating: 200 psi.
  4. WSP Rating: 125 psi at 450 degrees F.
  5. Body: ASTM A126, gray cast iron with bolted bonnet.
  6. End Connections: Flanged or threaded.
  7. Trim: Composition.
  8. Seat Ring and Disc Holder: Bronze.
  9. Disc: PTFE.
  10. Gasket: Asbestos free.
  11. Manufacturers:
    - a. Aalberts integrated piping systems; Apollo Valves.
    - b. Legend Valve & Fitting Inc.
    - c. Milwaukee Valve Corporation.
    - d. NIBCO Inc.
    - e. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.8 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125 with Lever and Spring-Closure Control.
  - 1. Comply with MSS SP-71, Type I.
  - 2. Description:
    - a. CWP Rating: 200 psi.
    - b. Design: Clear or full waterway.
    - c. Body: ASTM A126, gray iron with bolted bonnet.
    - d. Ends: Flanged as indicated.
    - e. Trim: Bronze.
    - f. Gasket: Asbestos free.
    - g. Closer Control: Factory installed, exterior lever, and weight.
  - 3. Manufacturers:
    - a. Aalberts integrated piping systems; Apollo Valves.
    - b. Flomatic Valves.
    - c. Mueller Co. LLC.
    - d. United water Products.
    - e. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.9 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Attachment: For connection to ball, butterfly, and gate valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
  - 4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.
- B. Manufacturers:
  - 1. Babbit Steam Specialty Co.
  - 2. Roto Hammer Industries; A Rotork Brand.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

### 3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Swing Check: Install horizontal maintaining hinge pin level.
- D. Provide chainwheels on operators for valves 4 inch and larger where located 96 inches or more above finished floor, terminating 60 inches above finished floor.

**END OF SECTION**



## **SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Prefabricated trapeze-framed systems.
- B. Strut systems for pipe or equipment support.
- C. Beam clamps.
- D. Pipe hangers.
- E. Pipe rollers and roller supports.
- F. Pipe supports, guides, shields, and saddles.
- G. Anchors and fasteners.
- H. Sway bracing.
- I. Pipe joint restraints.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 05 50 00 - Metal Fabrications.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
- K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- L. FM (AG) - FM Approval Guide.
- M. MFMA-4 - Metal Framing Standards Publication.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- O. UL (DIR) - Online Certifications Directory.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, post-installed concrete and masonry anchors, thermal insulated pipe supports, sway bracing, and pipe joint restraints.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
  1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- D. Derating Calculations for Fiberglass Strut Channel Framing Systems: Indicate load ratings adjusted for applicable service conditions.
- E. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports.
- F. Installer's Qualifications: Include evidence of compliance with specified requirements.
- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

## 1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.
- D. Installer Qualifications for Field-Welding: As specified in Section 05 50 00.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.



- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Materials for Metal Fabricated Supports: Comply with Section 05 50 00.
  - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
  - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
  - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
  - 2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

## 2.2 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

- A. Prefabricated Trapeze-Framed Metal Strut Systems:
  - 1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. Gripple, Inc.
    - c. Unistrut, a Atkore brand.
    - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
  - 3. MFMA-4 compliant, prefabricated, side-loading continuous-slot metal strut channel bracket with associated tracks, fittings, and related accessories.
  - 4. Strut Channel or Bracket Material:
    - a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
  - 5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
  - 6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
  - 7. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, j-hooks, protectors, and vibration dampeners.

## 2.3 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

- A. Strut Channels:
  - 1. Manufacturers:
    - a. ABB Installation Products.
    - b. ASC Engineered Solutions.
    - c. Gripple, Inc.
    - d. Unistrut, a brand of Atkore International Inc.
    - e. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
  - 3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

- B. Hanger Rods:
  - 1. Threaded zinc-plated steel unless otherwise indicated.
  - 2. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2 inch diameter.
    - b. Piping up to 1 inch: 1/4 inch diameter.
    - c. Piping larger than 1 inch: 3/8 inch diameter.
    - d. Trapeze Support for Multiple Pipes: 3/8 inch in length.
- C. Channel Nuts:
  - 1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. B-Line, a brand of Eaton Corporation.
    - c. Unistrut, a brand of Atkore International, Inc.
    - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

## 2.4 BEAM CLAMPS

- A. Manufacturers:
  - 1. ASC Engineered Solutions.
  - 2. B-Line, a brand of Eaton Corporation.
  - 3. Unistrut, a brand of Atkore International, Inc.
  - 4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- C. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
- D. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- E. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- F. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- G. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- H. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

## 2.5 PIPE HANGERS

- A. Swivel Ring Hangers, Adjustable: NPS 1/2 to NPS 3.
  - 1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. B-Line, a brand of Eaton Corporation.
    - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. MSS SP-58 type 10, epoxy-painted, zinc-colored.
  - 3. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
  - 4. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
  - 5. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- B. Clevis Hangers, Adjustable: NPS 1/2 to NPS 30.
  - 1. Manufacturers:
    - a. ASC Engineered Solutions.

- b. B-Line, a brand of Eaton Corporation.
- c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

## 2.6 PIPE CLAMPS

- A. Riser Clamps:
  1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. B-Line, a brand of Eaton Corporation.
    - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
  3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
  4. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
- B. Insulation Coupling:
  1. Manufacturers:
    - a. Flex-Struct, Inc.
    - b. Unistrut, a brand of Atkore International, Inc.
    - c. Hydar-Zorb.
    - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. Two bolt-type clamps designed for installation under insulation.
  3. Material: Carbon steel with epoxy copper or zinc finish.

## 2.7 PIPE ROLLERS AND ROLLER SUPPORTS

- A. Manufacturers:
  1. ASC Engineered Solutions.
  2. B-Line, a brand of Eaton Corporation.
  3. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
- C. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
- D. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

## 2.8 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Stanchions:
  1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. B-Line, a brand of Eaton Corporation.
    - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.

3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
- C. U-Bolts:
1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. B-Line, a brand of Eaton Corporation.
    - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- D. Pipe Shields for Insulated Piping:
1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. B-Line, a brand of Eaton Corporation.
    - c. Buckaroos, Inc.
    - d. National Pipe hanger Corporation.
    - e. Pipe Shields, Inc.
    - f. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. MSS SP-58 type 40.
  3. General Construction and Requirements:
    - a. Shields Material: Galvanized steel, 18 gauge, ASTM A527, formed to fit insulated outer diameters per ASTM C585.
    - b. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- E. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
  2. Liquid Temperatures Up to 122 degrees F:
    - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
    - b. Support From Below: MSS SP-58 types 35 through 38.
  3. Operating Temperatures from 122 to 446 degrees F:
    - a. Overhead Support: MSS SP-58 type 1 or 3 through 12 clamps with appropriate saddle of MSS SP-58 type 40 for insulated pipe.
    - b. Roller Chair: MSS SP-58 types 41 or 43 through 46 roller chair support with appropriate saddle of MSS SP-58 type 39 for insulated pipe.
    - c. Sliding Support: MSS SP-58 types 35 through 38.
- F. Pipe Supports, Thermal Insulated:
1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. Buckaroos, Inc.
    - c. National Pipe hanger Corporation.
    - d. Pipe Shields, Inc.
  2. General Requirements:
    - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    - b. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation.
    - c. Provide pipe supports for 1/2 to 30 inch iron pipes.
    - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by 360 degree, PVC jacketing.
  3. PVC Jacket:
    - a. Pipe insulation protection shields to be provided.

- b. Minimum Service Temperature: Minus 40 degrees F.
  - c. Maximum Service Temperature: 180 degrees F.
  - d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
  - e. Minimum Thickness: 60 mil, 0.06 inch.
  - f. Connections: Brush-on welding adhesive.
4. Products:
- a. Buckaroos, Inc.
  - b. Carpenter & Paterson, Inc.
  - c. National Pipe Hanger Corporation.
  - d. Pipe Shields, Inc.
  - e.
  - f. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Copper Pipe Supports:
- 1. Manufacturers:
    - a. ASC Engineered Solutions.
    - b. B-Line, a brand of Eaton Corporation.
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
    - d. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.

## 2.9 ANCHORS AND FASTENERS

- A. Manufacturers - Mechanical Anchors:
- 1. DeWALT Anchors & Fasteners.
  - 2. Hilti, Inc.
  - 3. ITW Red Head, a division of Illinois Tool Works, Inc.
  - 4. Simpson Strong-Tie Company Inc.
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Manufacturers - Powder-Actuated Fastening Systems:
- 1. DeWALT Anchors & Fasteners.
  - 2. Hilti, Inc.
  - 3. ITW Ramset, a division of Illinois Tool Works, Inc.
  - 4. Simpson Strong-Tie Company Inc.
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- D. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- E. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- F. Hollow Masonry: Use toggle bolts.
- G. Hollow Stud Walls: Use toggle bolts.
- H. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- I. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
- J. Sheet Metal: Use sheet metal screws.
- K. Wood: Use wood screws.
- L. Plastic and lead anchors are not permitted.
- M. Powder-actuated fasteners are permitted only as follows:
- 1. Where approved by Architect.
  - 2. Use only threaded studs; do not use pins.

- N. Hammer-driven anchors and fasteners are permitted only as follows:
  - 1. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
  - 2. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
- O. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- P. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
  - 1. Channel Material: Use galvanized steel.
  - 2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
  - 3. Manufacturer: Same as manufacturer of metal strut channel framing system.
- Q. Concrete Inserts:
  - 1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation.
    - b. HoldRite, a brand of Reliance Worldwide Corporation.
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
    - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

## 2.10 SWAY BRACING

- A. Manufacturers:
  - 1. ASC Engineered Solutions.
  - 2. B-Line, a brand of Eaton Corporation.
  - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Unless otherwise indicated and where not otherwise restricted, use the sway bracing products indicated below for a complete assembly.
- C. Structural Attachments: Universal sway brace attachment for lateral or longitudinal bracing, attached to rigid restraint.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads, attached to structural attachment and sway brace attachment.
- E. Sway Brace Attachments: Swivel type for lateral or longitudinal bracing, attached to all thread hanger rod.

## 2.11 PIPE JOINT RESTRAINTS

- A. Manufacturers:
  - 1. HoldRite.
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.
  - 3. Drain, waste, and vent pipe joint restraints for cast iron hubless (no hub) piping: 16 gauge galvanized straps, galvanized and heavy duty black steel pipe clamps, and standard bolts and nuts.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Unless specifically indicated or approved by Architect, do not provide support from bottom chord of steel bar joists and trusses.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Field-Welding (where approved by Architect): Comply with Section 05 50 00.
- I. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- J. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
  - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- K. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- L. Secure fasteners according to manufacturer's recommended torque settings.
- M. Sway Bracing: Install sway bracing systems according to manufacturer's written installation instructions.
- N. Pipe Joint Restraints: Install pipe joint restraints according to manufacturer's written installation instructions.
- O. Remove temporary supports.

### **3.3 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**





## **SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers (labels).
- E. Ceiling tacks.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 09 91 23 - Interior Painting: Identification painting.

#### **1.3 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Schedules:
  - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
  - 2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
  - 3. Valve Data Format: Include id-number, location, function, and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

### **PART 2 PRODUCTS**

#### **2.1 PLUMBING COMPONENT IDENTIFICATION GUIDELINE**

- A. Nameplates:
  - 1. Heat exchangers, water heaters, and other heat transfer products.
  - 2. Control panels, transducers, and other related control equipment products.
  - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
  - 1. Piping: 3/4 inch diameter and smaller.
  - 2. Manual operated and automated control valves.
  - 3. Instrumentation, relays, gauges, and other related control equipment products.
  - 4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.
- C. Pipe Markers: 3/4 inch diameter and higher.

#### **2.2 NAMEPLATES**

- A. Manufacturers:
  - 1. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe markers.
  - 4. emedco.
  - 5. Kolbi Pipe Marker Co.
  - 6. Marking Services, Inc.
  - 7. Seton Identification Products.

- B. Description: Laminated piece with up to three lines of text.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/4 inch.
  - 3. Background Color: Black.
  - 4. Nameplate Height: 3/4 inch.
  - 5. Nameplate Material:
    - a. Flexible: Vinyl with adhesive backing per ASTM D709.
    - b. Metal: Brass with center-side holes for screw fastening.

### 2.3 TAGS

- A. Manufacturers:
  - 1. Brady Corporation.
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe Markers.
  - 4. emedco.
  - 5. Kolbi Pipe Marker Co.
  - 6. Marking Services, Inc.
  - 7. Seton Identification Products.
- B. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch in diameter.
- C. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- D. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.
- E. Piping: 3/4 inch diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

### 2.4 STENCILS

- A. Manufacturers:
  - 1. Brady Corporation.
  - 2. Craftmark Pipe Markers.
  - 3. Kolbi Pipe Marker Co
  - 4. Seton Identification Products.
- B. Pipe: Stencil size required per external insulated or uninsulated pipe diameter.
  - 1. 3/4 to 1-1/4 inch Range: 1/2 inch text over 8 inch long background.
  - 2. 1-1/2 to 2 inch Range: 3/4 inch text over 8 inch long background.
  - 3. 2-1/2 to 6 inch Range: 1-1/4 inch text over 12 inch long background.
  - 4. 8 to 10 inch Range: 2-1/2 inch text over 24 inch long background.
  - 5. Over 10 inches: 3-1/2 inch text over 32 inch long background.
- C. Equipment: Use 2-1/2 inch text using Owner defined scheme.
- D. Background Paint: Semi-gloss enamel in compliance with Section 09 91 23.
- E. Stencil Paint: As specified in Section 09 91 23, semi-gloss enamel, colors complying with ASME A13.1.
- F. Fluid Service Identification Scheme, ASME A13.1:
  - 1. Water; Potable, Cooling, Boiler Feed and Other: White text on green background.

### 2.5 PIPE MARKERS (LABELS)

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar Industries, Inc.
  - 3. Craftmark Pipe Markers.
  - 4. Kolbi Pipe Marker Co.

5. emedco.
  6. Marking Services, Inc.
  7. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.
- F. Identification Scheme, ASME A13.1:
1. Primary: External Pipe Diameter, Uninsulated or Insulated.
    - a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
    - b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
    - c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
    - d. 8 to 10 inches: Use 24 inch field-length with 2-1/2 inch text height.
    - e. Over 10 inches: Use 32 inch field-length with 3-1/2 inch text height.
  2. Secondary: Color scheme per fluid service.
    - a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
  3. Tertiary: Other Details.
    - a. Directional flow arrow.

## 2.6 CEILING TACKS

- A. Manufacturers:
1. Craftmark Pipe Markers.
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Color code as follows:
1. Plumbing Equipment: Yellow.
  2. Plumbing Valves: Green.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive identification products.
- B. Prepare surfaces for stencil painting, see Section 09 91 23.

### 3.2 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping
- C. Apply stencil painted identification in compliance with Section 09 91 23 requirements. Identify unit with assigned id-number and area being served using pipe marking rules.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Apply ASME A13.1 Pipe Marking Rules:
1. Place pipe marker adjacent to changes in direction.
  2. Place pipe marker adjacent each valve port and flange end.
  3. Place pipe marker at both sides of floor and wall penetrations.



4. Place pipe marker every 25 to 50 feet interval of straight run.
- H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**

## SECTION 22 07 19 - PLUMBING PIPING INSULATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Flexible elastomeric cellular insulation.
- B. Glass fiber insulation.
- C. Jacketing and accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.

#### 1.3 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- G. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- J. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

#### 1.6 MOCK-UPS

- A. Provide the following mock-ups:
  - 1. Straight pipe: One straight 10 foot section of NPS 2.
  - 2. Fittings: One elbow and one tee for each pipe connection type (soldered, threaded, grooved mechanical coupling, flanged, and pressure seal joint).
  - 3. Valves: One NPS 2 or smaller and one NPS 2-1/2 or larger.
  - 4. Strainers: One of each piping connection type with removable insulation.

5. Hangers and supports: One for each horizontal and vertical, above and below ambient temperature system, including thermal insulated pipe supports and shields.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

## 1.8 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

## PART 2 PRODUCTS

### 2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

### 2.2 GLASS FIBER INSULATION

- A. Manufacturers:
  1. Johns Manville Corporation.
  2. Knauf Insulation.
  3. Manson Insulation.
  4. Owens Corning Corporation.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  1. K Value: ASTM C177, 0.24 at 75 degrees F.
  2. Maximum Service Temperature: 850 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
  1. K Value: ASTM C177, 0.23 at 75 degrees F.
  2. Maximum Service Temperature: 220 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
  1. K Value: ASTM C177, 0.24 at 75 degrees F.
  2. Maximum Service Temperature: 650 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- E. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
- F. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- G. Vapor Barrier Lap Adhesive: Compatible with insulation .
- H. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- I. Fibrous Glass Fabric:
  1. Cloth: Untreated; 9 oz/sq yd weight.
  2. Blanket: 1.0 pcf density.
  3. Weave: 5 by 5.
- J. Indoor Vapor Barrier Finish:
  1. Cloth: Untreated; 9 oz/sq yd weight.
  2. Vinyl emulsion type acrylic, compatible with insulation, white color.
- K. Insulating Cement: ASTM C449.

## 2.3 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
  - 1. Aeroflex USA.
  - 2. Armacell LLC.
  - 3. K-Flex USA LLC.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
  - 1. Minimum Service Temperature: Minus 40 degrees F.
  - 2. Maximum Service Temperature: 220 degrees F.
  - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

## 2.4 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
  - 1. Manufacturers:
    - a. Johns Manville Corporation.
  - 2. Jacket: UV resistant. one piece molded type fitting covers and sheet material.
    - a. Minimum Service Temperature: 0 degrees F.
    - b. Maximum Service Temperature: 150 degrees F.
    - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 30 mil, 0.030 inch.
    - e. Connections: Brush on welding adhesive.
  - 3. Covering Adhesive Mastic: Compatible with insulation.
  - 4. Color: White.
- B. Reinforced Tape:
  - 1. Manufacturers:
    - a. 3M; VentureClad.
    - b. Avery Dennison Corporation; Performance Tapes.
    - c. Ideal Tape Co., Inc.
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
  - 2. All Service Jacket tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
  - 3. Comply with UL 723 or ASTM E84.
  - 4. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
  - 5. Finish: Match insulation.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.

- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
  - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- H. Glass fiber insulated pipes conveying fluids above ambient temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert Location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range. See section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment for thermal insulated pipe supports.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

### 3.3 SCHEDULES

- A. Plumbing Piping Systems, Indoors Above Grade:
  - 1. Domestic Hot Water Supply:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: NPS 1-1/4 and smaller.
      - 2) Thickness: 1 inch.
      - 3) Pipe Size Range: NPS 1-1/2 and larger.
      - 4) Thickness: 1-1/2 inch.
    - b. Flexible Elastomeric Cellular Insulation:
      - 1) Pipe Size Range: 1-1/4 and smaller inch.
      - 2) Thickness: 1 inch.
      - 3) Pipe Size Range: NPS 1-1/2 and larger.
      - 4) Thickness: 1-1/2 inch.
  - 2. Domestic Hot Water Recirculation:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: NPS 1-1/4 and smaller.
      - 2) Thickness: 1 inch.
      - 3) Pipe Size Range: NPS 1-1/2 and larger.
      - 4) Thickness: 1-1/2 inch.
    - b. Flexible Elastomeric Cellular Insulation:
      - 1) Pipe Size Range: 1-1/4 and smaller inch.
      - 2) Thickness: 1 inch.



- 3) Pipe Size Range: NPS 1-1/2 and larger.
  - 4) Thickness: 1-1/2 inch.
  - 3. Domestic Cold Water:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: NPS 1-1/4 and smaller.
      - 2) Thickness: 1/2 inch.
      - 3) Pipe Size Range: NPS 1-1/2 and larger.
      - 4) Thickness: 1 inch.
    - b. Flexible Elastomeric Cellular Insulation:
      - 1) Pipe Size Range: NPS 1-1/4 and smaller.
      - 2) Thickness: 1/2 inch.
      - 3) Pipe Size Range: NPS 1-1/2 and larger.
      - 4) Thickness: 1 inch.
  - 4. Roof Drain Bodies (Primary and Overflow):
    - a. Flexible Elastomeric Cellular Insulation:
      - 1) Thickness: 1 inch.
  - 5. Storm Drains Above Grade:
    - a. Glass Fiber Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1 inch.
    - b. Flexible Elastomeric Cellular Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1 inch.
    - c. Cellular Glass Insulation:
      - 1) Pipe Size Range: All sizes.
      - 2) Thickness: 1-1/2 inch.
- B. Other Systems:
- 1. Sanitary Drains with Heat Tracing:
    - a. Pipe Size Range: All sizes.
    - b. Thickness: 1-1/2 inch.
  - 2. Storm Drains with Heat Tracing:
    - a. Pipe Size Range: All sizes.
    - b. Thickness: 1-1/2 inch.

**END OF SECTION**



## SECTION 22 10 05 - PLUMBING PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet of building.
- B. Sanitary waste and vent piping, above grade.
- C. Domestic water piping, above grade.
- D. Storm drainage piping, buried within 5 feet of building.
- E. Storm drainage piping, above grade.
- F. Pipe flanges, unions, and couplings.
- G. Pipe hangers and supports.
- H. Pipe sleeve-seal systems.
- I. Balancing valves.
- J. Strainers.

#### 1.2 RELATED REQUIREMENTS

- A. Section 08 31 00 - Access Doors and Panels.
- B. Section 09 91 23 - Interior Painting.
- C. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
- D. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- E. Section 22 07 19 - Plumbing Piping Insulation.
- F. Section 31 23 16 - Excavation.
- G. Section 31 23 23 - Fill.

#### 1.3 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- C. ASME B31.9 - Building Services Piping.
- D. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- E. ASTM B32 - Standard Specification for Solder Metal.
- F. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- H. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
- I. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
- J. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- K. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- L. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- M. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

- N. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- O. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
- P. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- R. AWWA C651 - Disinfecting Water Mains.
- S. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- T. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- U. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential.
- V. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- W. NSF 61 - Drinking Water System Components - Health Effects.
- X. NSF 372 - Drinking Water System Components - Lead Content.
- Y. UL (DIR) - Online Certifications Directory.
- Z. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, plastic piping primer and cements, and accessories. Provide manufacturers catalog information.
- C. Sustainable Design Documentation: For products meeting regulatory lead-content restrictions.
- D. Test Reports: Submit a copy of the final piping test reports approved by the Authority Having Jurisdiction to the Architect/ Engineer.

#### **1.5 QUALITY ASSURANCE**

- A. Perform work in accordance with applicable codes.
- B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### **1.7 FIELD CONDITIONS**

- A. Do not install underground piping when bedding is wet or frozen.

### **PART 2 PRODUCTS**

#### **2.1 GENERAL REQUIREMENTS**

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

## **2.2 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Cast Iron Pipe: ASTM A74 service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless.
  - 1. Fittings: Cast iron.
  - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies. (Shielded, Standard No-Hub Couplings.)
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

## **2.3 SANITARY WASTE AND VENT PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: ASTM A74, service weight.
  - 1. Fittings: Cast iron.
  - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies. (Shielded, Standard No-Hub Couplings.)

## **2.4 DOMESTIC WATER PIPING, ABOVE GRADE**

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - 2. Joints: ASTM B32, alloy Sn95 solder.
  - 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
    - a. Manufacturers:
      - 1) SCI Press; an ASC Engineered Solutions brand
      - 2) Aalberts integrated piping systems; Apollo Press.
      - 3) Mueller Streamline Co.
      - 4) Nibco.
      - 5) Viega LLC.

## **2.5 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING**

- A. Cast Iron Pipe: ASTM A74 service weight.
  - 1. Fittings: Cast iron.
  - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: Shielded, Heavy Duty No-Hub Couplings.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

## **2.6 STORM DRAINAGE PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: ASTM A74 service weight.
  - 1. Fittings: Cast iron.
  - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies. (Shielded, Heavy Duty No-Hub Couplings.)

## **2.7 PIPE FLANGES, UNIONS, AND COUPLINGS**

- A. Unions for Pipe Sizes 3 inch and Under:
  - 1. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Sizes Over 1 inch:
  - 1. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. No-Hub Couplings:
  - 1. Testing: In accordance with ASTM C1277 and CISPI 310.
  - 2. Gasket Material: Neoprene complying with ASTM C564.
  - 3. Band Material: Stainless steel.
  - 4. Eyelet Material: Stainless steel.
  - 5. Manufacturers:
    - a. Anaco.
    - b. Charlotte Pipe and Foundry Company.
    - c. Fernco, Inc.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company LLC.
    - f. Tyler Pipe & Coupling.
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Shielded, Heavy Duty No-Hub Couplings:
  - 1. Testing: In accordance with ASTM C1540 and FM 1680.
  - 2. Gasket Material: Neoprene complying with ASTM C564.
  - 3. Band Material: Stainless steel.
  - 4. Eyelet Material: Stainless steel.
  - 5. Manufacturers:
    - a. Anaco.
    - b. Charlotte Pipe and Foundry Company.
    - c. Fernco, Inc.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company LLC.
    - f. Tyler Pipe & Coupling.
    - g. MIFAB, Inc.
    - h. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Dielectric Connections: Union or nipple with galvanized or plated steel threaded end, copper solder end, grooved end, water impervious isolation barrier.

## **2.8 PIPE HANGERS AND SUPPORTS**

- A. See Section 22 05 29 for additional requirements.
- B. Provide hangers and supports that comply with MSS SP-58.
  - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
  - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
  - 4. Vertical Pipe Support: Steel riser clamp.
  - 5. Floor Supports: Steel pedestal with base stand and adjustable pipe saddle support.
- C. Plumbing Piping - Drain, Waste, and Vent:

1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
  2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
  3. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
  4. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- D. Plumbing Piping - Water:
1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
  2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
  3. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.
  4. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
  5. Floor Support for Hot Pipe Sizes to 4 inch: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and steel support.
  6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- E. Hanger Fasteners: Attach hangers to structure using appropriate fasteners: See Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
- F. Sway Bracing: Attach to structure. See Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.
- G. Pipe Joint Restraints: Attach to piping. See Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment.

## 2.9 PIPE SLEEVE-SEAL SYSTEMS

- A. Manufacturers:
1. Advance Products & Systems, LLC.
  2. Flexicraft Industries.
  3. Garlock, an Enpro Inc. Co.
  4. The Metraflex Company
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Modular Mechanical Seals:
1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
  2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
  3. Size and select seal component materials in accordance to service requirements.
  4. Service Requirements:
    - a. Corrosion resistant.
    - b. Underground, buried, and wet conditions.
    - c. Fire Resistant: 1 hour, UL (DIR) approved.
    - d. High Temperature, up to 250 deg F.
    - e. Low temperature, down to minus 67 deg F.
  5. Glass reinforced plastic pressure end plates.
  6. Type 316 stainless steel bolts and nuts.
- C. Wall Sleeve: Steel material with water-stop collar, and nailer end-caps.

## 2.10 BALANCING VALVES

- A. Manufacturers:
1. Bell & Gossett; a xylem brand.
  2. WATTS.
  3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Manually operated ball type, triple purpose balancing valve, Size 1/2 to 3 inch:

1. Class 125 brass or bronze lead free body, stainless steel ball, glass and carbon filled seat rings, EPDM stem O-ring, calibrated nameplate and memory stop indicator, dual capped brass read out valves with internal check valves, tapped and plugged drain port, 400 psi working pressure, minus 4 to 250 deg F, threaded or soldered connections, standard and restricted flow.
- C. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

## 2.11 STRAINERS

- A. Manufacturers:
1. Armstrong International, Inc.
  2. Febco; a WATTS brand.
  3. Green Country Filter Manufacturing.
  4. Mueller Steam Specialty; a WATTS brand.
  5. WATTS.
  6. WEAMCO.
  7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Size 1/2 inch to 3 inch:
1. Class 150, threaded or soldered forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi, 250 deg F WOG service.
- C. Size 2 inch and Smaller:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
  2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- D. Size 1-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
- E. Size 5 inch and Larger:
1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
1. See Section 22 07 19.



- G. Provide access where valves and fittings are not exposed.
  - 1. Coordinate size and location of access doors with Section 08 31 00.
- H. Establish elevations of buried piping outside the building to ensure not less than 4 ft of cover.
- I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
  - 1. See Section 09 91 23 for painting of interior plumbing systems and components.
- L. Excavate in accordance with Section 31 23 16.
- M. Backfill in accordance with Section 31 23 23.
- N. Install bell and spigot pipe with bell end upstream.
- O. Install valves with stems upright or horizontal, not inverted. See Section 22 05 23.
- P. Install water piping to ASME B31.9.
- Q. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- R. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- S. Sleeve pipes passing through partitions, walls, and floors.
- T. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.9.
  - 2. Support horizontal piping as indicated.
  - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  - 4. Place hangers within 12 inches of each horizontal elbow.
  - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 8. Provide copper plated hangers and supports for copper piping.
  - 9. Support cast iron drainage piping at every joint.
  - 10. Furnish and Install sway bracing and pipe joint restraints for drain piping 4 inch and larger as required by the Plumbing Code.
- U. Pipe Sleeve-Seal Systems:
  - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  - 3. Locate piping in center of sleeve or penetration.
  - 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  - 5. Tighten bolting for a watertight seal.
  - 6. Install in accordance with manufacturer's recommendations.
- V. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.4 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.

- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Provide flow controls in water recirculating systems where indicated.

### 3.5 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

### 3.6 FIELD TESTS AND INSPECTIONS

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Drainage and Vent Systems:
  - 1. Test for defects and leaks in new piping.
  - 2. Water Test:
    - a. Pipe openings shall be closed tightly, except the highest opening, and fill with water to the point of overflow, but no less than 10 foot head of water.
    - b. Hold pressure for no less than 15 minutes.
    - c. Inspect all joints for leaks.
    - d. Finished Plumbing Test: After plumbing fixtures have been set and traps filled with water, test connections and prove they are watertight and gas tight.
- C. Domestic Water Systems:
  - 1. Perform hydrostatic testing for leakage prior to system disinfection.
  - 2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
  - 3. General:
    - a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.
- D. Test Results: Document and certify successful results, otherwise repair, document, and retest.

### 3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfection of domestic water piping shall be done as prescribed by the Authorities having Jurisdiction. If Authorities having Jurisdiction do not have prescribed methods, comply with AWWA C651 or as described below:
  - 1. Prior to starting work, verify system is complete, flushed, and clean.
  - 2. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
  - 3. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
  - 4. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
  - 5. Maintain disinfectant in system for 24 hours.
  - 6. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
  - 7. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
  - 8. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

### 3.8 SCHEDULES

- A. Pipe Hanger Spacing:
  - 1. Cast Iron Drain and Vent Piping:
    - a. Pipe Size: 1 1/2 inch to 2 inch:
      - 1) Maximum Hanger Spacing: 5 ft.
      - 2) Hanger Rod Diameter: 3/8 inches.

- b. Pipe Size: 3 inch:
    - 1) Maximum Hanger Spacing: 5 ft.
    - 2) Hanger Rod Diameter: 1/2 inches.
  - c. Pipe Size: 4 inch and 5 inch:
    - 1) Maximum Hanger Spacing: 5 ft.
    - 2) Hanger Rod Diameter: 5/8 inches.
  - d. Pipe Size: 6 inch and 8 inch:
    - 1) Maximum Hanger Spacing: 5 ft.
    - 2) Hanger Rod Diameter: 3/4 inches.
  - e. Pipe Size: 10 inch and 12 inch:
    - 1) Maximum Hanger Spacing: 5 ft.
    - 2) Hanger Rod Diameter: 7/8 inches.
  - f. Pipe Size for 10 foot pipe lengths: 1 1/2 inch to 12 inch:
    - 1) Maximum Hanger Spacing: 10 ft.
    - 2) Hanger Rod Diameter: Refer to a through e above.
  - g. Vertical Piping Size 1 1/2 inch to 12 inch:
    - 1) Base of piping, at each floor, and 15 ft maximum support spacing.
2. Copper Domestic Water Piping:
- a. Pipe Size: 3/4 inch and smaller:
    - 1) Maximum Hanger Spacing: 5 ft.
    - 2) Hanger Rod Diameter: 3/8 inches.
  - b. Pipe Size: 1 inch to 1 1/4 inch:
    - 1) Maximum Hanger Spacing: 6 ft.
    - 2) Hanger Rod Diameter: 3/8 inches.
  - c. Pipe Size: 1 1/2 inch to 2 inch:
    - 1) Maximum Hanger Spacing: 8 ft.
    - 2) Hanger Rod Diameter: 3/8 inches.
  - d. Pipe Size: 2 1/2 inch:
    - 1) Maximum Hanger Spacing: 9 ft.
    - 2) Hanger Rod Diameter: 1/2 inches.
  - e. Pipe Size: 3 inch:
    - 1) Maximum Hanger Spacing: 10 ft.
    - 2) Hanger Rod Diameter: 1/2 inches.
  - f. Pipe Size: 3 inch to 5 inch:
    - 1) Maximum Hanger Spacing: 10 ft.
    - 2) Hanger Rod Diameter: 1/2 inches.
  - g. Pipe Size: 6 inch:
    - 1) Maximum Hanger Spacing: 10 ft.
    - 2) Hanger Rod Diameter: 5/8 inches.
  - h. Pipe Size: 8 inch:
    - 1) Maximum Hanger Spacing: 10 ft.
    - 2) Hanger Rod Diameter: 3/4 inches.
  - i. Vertical Piping Size 1 1/2 inch to 8 inch:
    - 1) Base of piping, at each floor, and 10 ft maximum support spacing.

**END OF SECTION**



## SECTION 22 10 06 - PLUMBING PIPING SPECIALTIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Washing machine outlet boxes.
- F. Ice maker outlet boxes.
- G. Water hammer arrestors.
- H. Sanitary waste interceptors.
- I. Mixing valves.
- J. Floor drain trap seals.

#### 1.2 RELATED REQUIREMENTS

- A. Section 22 10 05 - Plumbing Piping.
- B. Section 22 40 00 - Plumbing Fixtures.

#### 1.3 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor Drains.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains.
- C. ASME A112.18.1 - Plumbing Supply Fittings.
- D. ASME A112.21.3M - Hydrants for Utility and Maintenance Use.
- E. ASME A112.36.2 - Cleanouts.
- F. ASME B1.20.7 - Hose Coupling Screw Threads (Inch).
- G. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
- H. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
- I. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance.
- J. ASSE 1052 - Performance Requirements for Hose Connection Backflow Preventers.
- K. ASSE 1053 - Performance Requirements for Dual Check Backflow Preventer Wall Hydrants - Freeze Resistant Type.
- L. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices.
- M. ASSE 1072 - Performance Requirements for Barrier Type Trap Seal Protection for Floor Drains.
- N. NSF 372 - Drinking Water System Components - Lead Content.
- O. PDI-WH 201 - Water Hammer Arresters.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Certificates: Certify that grease interceptors meet or exceed specified requirements.

- E. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- F. Manufacturer's qualification statement.
- G. Operation Data: Indicate frequency of treatment required for interceptors.
- H. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements for additional provisions.
  - 2. Extra Loose Keys hose bibbs or wall hydrants: One.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.
- B. Source Limitations: Products shall be obtained from a single manufacturer for each product category and type whenever possible. If not possible, obtain similar products from other listed manufacturers for each category and type.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

### 2.2 DRAINS

- A. Primary Roof Drain (RD-1):
  - 1. Basis of Design: Jay R. Smith 1015-E(2)-C-CID.
  - 2. Assembly: ASME A112.6.4.
  - 3. Body: Lacquered cast iron with sump.
  - 4. Strainer: Removable cast iron dome.
  - 5. Accessories: Coordinate with roofing type:
    - a. Membrane flange and membrane clamp with integral gravel stop.
    - b. Adjustable under deck clamp.
    - c. Roof sump receiver.
    - d. Outlet: Bottom.
    - e. Adjustable extension with reversible collar for roof insulation.
    - f. Fixed 2 inch extension for roof insulation.
  - 6. Manufacturers:
    - a. Jay R. Smith Manufacturing Company.
    - b. Josam.
    - c. MIFAB, Inc.
    - d. Wade.
    - e. Watts.
    - f. Zurn Industries, LLC.
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Overflow Roof Drain ORD-1:
  - 1. Basis of Design: Jay R. Smith 1045-E(4)-C-CID.
  - 2. Assembly: ASME A112.6.4.
  - 3. Body: Lacquered cast iron with sump.
  - 4. Strainer: Removable cast iron vandal proof dome.
  - 5. Accessories: Coordinate with roofing type:

- a. Membrane flange and membrane clamp with integral gravel stop.
  - b. Adjustable under deck clamp.
  - c. Roof sump receiver.
  - d. Outlet: Bottom.
  - e. Adjustable extension with reversible collar for roof insulation.
  - f. Fixed 4 inch extension for roof insulation.
6. Manufacturers:
- a. Jay R. Smith Manufacturing Company.
  - b. Josam.
  - c. MIFAB, Inc.
  - d. Wade.
  - e. Watts.
  - f. Zurn Industries, LLC.
  - g. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Downspout Nozzle (DSN-1):
1. Basis of Design: Jay R. Smith 1770.
  2. Cast Bronze and Nickel Bronze with matching wall plate with mounting holes.
  3. Manufacturers:
    - a. Jay R. Smith Manufacturing Company.
    - b. Josam.
    - c. MIFAB, Inc.
    - d. Wade.
    - e. Watts.
    - f. Zurn Industries, LLC.
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Floor Drains:
1. Manufacturers:
    - a. Jay R. Smith Manufacturing Company.
    - b. Josam.
    - c. MIFAB, Inc.
    - d. Wade.
    - e. Watts.
    - f. Zurn Industries, LLC.
    - g. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Floor Drain (FD-1):
1. Basis of Design: Jay R. Smith 2005-A6NB.
  2. Assembly: ASME A112.6.3.
  3. Body: Laquered cast iron, two piece body with double drainage flange, weep holes, and reversible clamping collar.
  4. Strainer: 6 inch round, adjustable nickel bronze, light duty.
  5. Trap: Standard P-Trap.
    - a. Accessories: Floor drain trap seal.
- F. Floor Drain (FD-2):
1. Basis of Design: Jay R. Smith 3510-F20-NB6
  2. Assembly: ASME A112.6.3.
  3. Body: Laquered cast iron, two piece body with double drainage flange, weep holes, and reversible clamping collar.
  4. Strainer: Round, adjustable nickel bronze, heavy duty.
  5. Accessories: 4 inch diameter by 4-1/4 inch high round funnel.
  6. Trap: Standard P-Trap.
    - a. Accessories: Floor drain trap seal.

## 2.3 CLEANOUTS

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company.
  - 2. Josam Company.
  - 3. MIFAB, Inc.
  - 4. Wade.
  - 5. Watts.
  - 6. Zurn Industries, LLC
  - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Cleanout (Unfinished Areas)FCO:
  - 1. Basis of Design: Jay R. Smith 4220 Series.
  - 2. Assembly: ASME A112.36.2.
  - 3. Body: Lacquered cast iron with anchor flange
  - 4. Closure Plug: Countersunk bronze.
  - 5. Cover and Frame: Lacquered cast iron, scoriated, secured, and adjustable to finished floor.
- C. Cleanout (Finished Areas)FCO:
  - 1. Basis of Design: Jay R. Smith 4100 Series.
  - 2. Assembly: ASME A112.36.2.
  - 3. Body: Lacquered cast iron with anchor flange
  - 4. Closure Plug: Countersunk bronze.
  - 5. Cover and Frame: Nickel bronze cast iron, scoriated, secured, and adjustable to finished floor.
- D. Cleanout (Finished Tiled Areas)FCO:
  - 1. Basis of Design: Jay R. Smith 4140 Series.
  - 2. Assembly: ASME A112.36.2.
  - 3. Body: Lacquered cast iron with anchor flange
  - 4. Closure Plug: Countersunk bronze.
  - 5. Cover and Frame: Nickel bronze, with 1/8 inch tile recess, secured, adjustable to finished floor.
- E. Cleanout (Finished Wall Areas)WCO:
  - 1. Basis of Design: Jay R. Smith 4530 Series.
  - 2. Assembly: ASME A112.36.2.
  - 3. Body: Duco cast iron cleanout tee.
  - 4. Closure Plug: Countersunk bronze.
  - 5. Cover: Stainless steel round cover with vandal proof set screw.
- F. Cleanout (Unfinished Wall Areas)WCO:
  - 1. Basis of Design: Jay R. Smith 4510 Series.
  - 2. Assembly: ASME A112.36.2.
  - 3. Body: Duco cast iron cleanout tee.
  - 4. Closure Plug: Countersunk bronze.

## 2.4 HOSE BIBBS

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company.
  - 2. Prier Products, Inc.
  - 3. Watts.
  - 4. Woodford Manufacturing Company, LLC.
  - 5. Zurn Industries, LLC.
  - 6. Substitutions: See Section 01 60 00 - Product Requirements.



- B. Interior Hose Bibb (exposed) (HB-1):
  - 1. Basis of Design: Woodford Model 26.
  - 2. Assembly: ASME A112.21.3M.
  - 3. Bronze or brass with mounting flange, replaceable seat, ASME B1.20.7 hose thread spout, and integral or add-on vacuum breaker complying with ASSE 1052.
  - 4. Finishes:
    - a. Exposed finished Locations: Chrome.
    - b. Mechanical and Equipment Rooms: Chrome.
    - c. Service Areas: Chrome.
  - 5. Operation:
    - a. Exposed Locations: Metal wheel handle .
    - b. Mechanical and Equipment Rooms: Metal wheel handle.
    - c. Service Areas: Metal wheel handle.

## 2.5 HYDRANTS

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company.
  - 2. Josam.
  - 3. Watts.
  - 4. Woodford Manufacturing Company, LLC.
  - 5. Zurn Industries, LLC.
  - 6. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Wall Hydrant (Non-Freeze Exposed) (WH-1):
  - 1. Basis of Design: Woodford Model 67.
  - 2. Assembly: ASME A112.21.3M.
  - 3. Freeze resistant, automatic self-draining, ASME B1.20.7 hose thread spout, and ASSE 1052 field testable backflow preventer.
    - a. Installation: Wall plate.
    - b. Finish: Chrome.
    - c. Operation: Loose tee key.

## 2.6 WASHING MACHINE OUTLET BOXES

- A. Galvanized Metal Washing Machine Outlet Box (WMB-1):
  - 1. Basis of Design: Guy Gray FB200.
  - 2. 20 gauge hot dip galvanized box and faceplate.
  - 3. Supplies: Separate ASME A112.18.1 cold and hot water quarter turn ball valves with ASME B1.20.7 threaded outlets.
  - 4. Drain: Right with 2 inch threaded male drain fitting and lock nut. 3 inch P-Trap (minimum).
  - 5. Manufacturers:
    - a. Guy Gray; IPS Corporation.
    - b. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.7 ICE MAKER OUTLET BOXES

- A. Galvanized Ice Maker Outlet Box (IOB-1):
  - 1. Basis of Design: Guy Gray Model BIM875.
  - 2. 20 gauge hot dip galvanized box and faceplate.
  - 3. Supply: ASME A112.18.1 cold water quarter turn ball valve with NPS 1/2 inch or smaller compression outlet.
  - 4. Manufacturers:
    - a. Guy Gray; IPS Corporation.
    - b. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.8 WATER HAMMER ARRESTORS

- A. Manufacturers:
  - 1. Cash Acme, a brand of Reliance Worldwide Corporation.
  - 2. Jay R. Smith Manufacturing Company.
  - 3. MIFAB.
  - 4. Sioux Chief Mfg. Co., Inc.
  - 5. Watts Regulator Company, a part of Watts Water Technologies.
  - 6. Zurn Industries, LLC.
  - 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Water Hammer Arrestors:
  - 1. ASSE 1010; Copper construction, piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

## 2.9 MIXING VALVES

- A. Water Temperature Limiting Valves (Individual Fixture):
  - 1. Basis of Design: Watts LFUSG-B.
  - 2. Manufacturers:
    - a. Cash Acme, a brand of Reliance Worldwide Corporation.
    - b. Leonard Valve Company.
    - c. POWERS, A Watts Brand.
    - d. Watts.
    - e. Substitutions: See Section 01 60 00 - Product Requirements.
  - 3. Valve: ASSE 1070, lead free bronze or brass body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment with high-temperature limit stop; integral check valves with strainer screens on inlets.
  - 4. Minimum Flow Rate: 0.25 gpm.

## 2.10 FLOOR DRAIN TRAP SEALS

- A. Manufacturers:
  - 1. Jay R. Smith mfg. Co.
  - 2. MIFAB, Inc.
  - 3. Rectorseal (SureSeal).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: ASSE 1072; Push-fit EPDM or silicone fitting with a one-way membrane.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install Plumbing Piping specialties in accordance with manufacturer's instructions.
- B. Install primary roof drains at low points of roof areas according to roof drain manufacturer's installation instructions.
  - 1. Install flashing clamp to prevent leakage between drain body and surrounding roofing membrane. Maintain integrity of waterproof membrane.
- C. Install overflow/ emergency roof drains to accept the full thickness of the roof insulation without a low point to the drain unless noted otherwise.
  - 1. Install flashing clamp to prevent leakage between drain body and surrounding roofing membrane. Maintain integrity of waterproof membrane.
- D. Install downspout nozzles at 18 inches above grade unless noted otherwise.
  - 1. Furnish and install splash block at areas without solid surface.
- E. Install floor drains at low points with strainers below the surrounding finished floor, unless indicated otherwise.

1. Install floor drain clamping collar to ensure no leakage occurs between drain and surrounding flooring, and maintain integrity of the waterproof membrane.
- F. Install trench drains at low points with grates below the surrounding finished floor, unless indicated otherwise. Secure grates to drain body with manufacturers hardware.
- G. Install floor sinks to receive indirect waste with rims above surrounding finished floor unless noted otherwise.
- H. Install cleanouts in underground and aboveground drain piping, and the following:
  1. Extend cleanouts to finished floor or wall surface.
  2. Lubricate threaded cleanout plugs UL Certified/ NSF Registered non-hardening, anti-seize heavy duty pipe thread sealant PTFE (Teflon). Ensure clearance at cleanout for rodding of drainage system.
  3. Encase exterior cleanouts in concrete (12 inches by 12 inches by 4 inches minimum) flush with grade.
  4. Install floor cleanouts at elevation to accommodate finished floor.
  5. Install cleanouts in accordance with the Plumbing code, and the following:
    - a. Same size as drainage piping. 4 inch size for drain piping 5 inches and larger, unless indicated otherwise.
    - b. Locate at each change of direction in horizontal drain piping greater than 45 degrees. Where ore that one change of direction greater than 45 degrees occurs within 40 feet of developed length of piping, the cleanout installed for the first change of direction shall serve as the cleanout for all changes in direction within that 40 feet of developed length of piping.
    - c. Minimum intervals of 100 feet. Refer to the Plumbing Plans for locations.
    - d. Locate at the base of each vertical stack.
    - e. Locate cleanouts for piping 6 inch and smaller to provide a minimum of 18 inches of clearance for rodding or cleaning of drainage piping; Locate cleanouts for piping 8 inch and larger to provide a minimum of 36 inches of clearance for rodding or cleaning of drainage piping.
    - f. Locate a cleanout within 10 feet upstream of the junction of the building drain and building sewer.
  6. Install interior hose bibbs and wall hydrants at 18 inches above finished floor unless indicated otherwise.
  7. Install exterior hose bibbs and wall hydrants at 18 inches above grade unless indicated otherwise.
  8. Install washing machine and ice maker outlet boxes recessed or surface mounted to wall. Install fire retardant 2 inch by 4 inch wood blocking wall reinforcement between studs (where applicable).
  9. Install backwater valves in building drain piping:
    - a. Interior installation: Furnish and install cleanout deck plate centered over valve cover, of adequate size, and include connected drain piping to ensure access to valve cover for removal and servicing.
  10. Install approved potable water backflow prevention assemblies on plumbing lines where cross connections from back-siphonage or back-pressure are present. Refer to the Plumbing Plans for sizes, types, and locations.
    - a. Pipe drain from backflow prevention assemblies to indirect waste receptor with air gap.
  11. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping including, but not limited to water closets, urinals, lavatories, sinks, washing machine outlets supplies, or shower valves, and in accordance with PDI-WH 201. Refer to the Plumbing Plans for sizes and locations.
  12. Install solids interceptors above floor. Furnish and install p-trap for interceptors without integral trap seal.



13. Install mixing valves with checkstops or shutoff valves on inlets and shutoff valve on outlet.
14. Install floor drain trap seals in drain outlet and in accordance with the manufacturers written installation instructions.

**END OF SECTION**

## SECTION 23 05 00 - HVAC SUMMARY OF WORK

### PART 1 - GENERAL

#### 1.1 SUMMARY OF WORK

- A. Contractor shall provide all labor, materials, equipment, permits, inspection fees, utility company charges, supervision and other items indicated in the contract General Conditions necessary to yield completely operable and tested systems as shown on the drawings and as specified herein. The Work includes, but is not limited to, the following:
- B. Hydronic hot water heating and chilled water cooling systems.
  - 1. Demolition of existing systems as shown.
  - 2. New hydronic hot water heating system(s).
  - 3. Modifications to the existing hydronic hot water heating system(s).
  - 4. Modifications to the existing chilled water cooling system(s).
- C. HVAC
  - 1. Demolition of existing systems as shown.
  - 2. New air handling systems and equipment.
  - 3. Modifications to the existing air handling systems and equipment.
  - 4. New refrigerant piping systems, including charging of systems.
  - 5. Modifications to the existing refrigerant piping systems, including evacuation and re-charging of systems.
  - 6. Installation of duct smoke detectors furnished by the Electrical Contractor.
  - 7. Coordination of smoke detector interface with the fire alarm system and with the operation of air handling equipment and devices.
  - 8. Combustion air and venting for fuel-fired appliances/equipment.
- D. Furnishing of variable frequency motor drives by the Temperature Controls Contractor, for installation by the Electrical Contractor.
- E. Piping, valve, and equipment identification.
- F. Mechanical insulation for piping, ductwork, and equipment.
- G. New temperature control system.
- H. Modifications to the existing temperature control system.
- I. All temperature and pressure instrumentation and wells not a part of the Temperature Control System.
- J. Prime and paint exterior above ground piping per specification 09 91 23 - Interior Painting.
- K. Touch-up painting of damaged materials furnished by this contractor and damaged prior to Owner occupancy. All materials shall match original color and finishes. All work shall be done by experienced field tradesmen.
- L. Protection of new and existing finishes and surfaces. Protect finished surfaces from damage due to mechanical work, including walls, floors, ceilings and roof.
- M. Flushing, cleaning, and pressure testing of installed systems.
- N. Cleanup associated with work of respective trades.
- O. Testing, adjusting and balancing of new systems and equipment.
- P. Testing, adjusting and balancing of existing systems and equipment, where indicated.
- Q. Commissioning of new equipment and systems.
- R. Commissioning of existing equipment and systems, where indicated.
- S. Provide As-Built Drawings at the completion of work.
- T. Operation and Maintenance Manuals.



- U. All new equipment shall comply with the testing agency listing and labeling requirements of the current edition of all applicable state and local codes.
- V. Equipment of each category shall be provided by single manufacturer.
- W. No asbestos or mercury containing materials, materials capable of discharging lead into potable water or air systems, or materials capable of releasing other hazardous substances to the facility air environment, drainage systems or water systems shall be used.
- X. Equipment schedules are provided as a convenience to the Contractor, but do not relieve the Contractor of his responsibility to furnish all equipment shown on the drawings and indicated in the specifications.
- Y. Coordination with all other trades. The Contractor shall assist in the field layout and coordination of equipment, ductwork, and piping installation and their relation with other trades at no additional cost to the Owner.
- Z. Provide minimum one (1) year warranty against defects for materials and installation, unless otherwise indicated.
- AA. Cost of state and/or local Mechanical permits, as required.
- BB. Job site safety is the responsibility of the contractor. The architect/engineer bears no responsibility for job-site safety.
- CC. Owner training in the operation and maintenance of installed equipment and systems. Using the Operating and Maintenance manuals, balancing report data, and contract drawings and specifications, the contractor shall instruct the Owner's representative(s) in the proper operation and maintenance of the equipment and systems installed to their mutual satisfaction. This activity shall take place near the point of substantial completion and will be considered a punch list item.

**END OF SECTION**

## SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Electronically Commutated Motors (ECM).

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

#### 1.3 REFERENCE STANDARDS

- A. NEMA MG 1 - Motors and Generators.
- B. NFPA 70 - National Electrical Code.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

#### 1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of high efficiency motors.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Baldor Electric Company/ABB Group.
- B. Leeson Electric Corporation:
- C. Regal-Beloit Corporation (Century).

#### 2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 05 83 for required electrical characteristics.

- B. Electrical Service:
  - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
  - 2. Motors Larger than 1/2 Horsepower: refer to plans for voltage, three phase, 60 Hz.
- C. Construction:
  - 1. Open drip-proof type except where specifically noted otherwise.
  - 2. Design for continuous operation in 104 degrees F environment.
  - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  - 4. Motors with frame sizes 254T and larger: Energy efficient type.
- D. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. Wiring Terminations:
  - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

### **2.3 SINGLE PHASE POWER - SPLIT PHASE MOTORS**

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.

### **2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.

### **2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS**

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

### **2.6 ELECTRONICALLY COMMUTATED MOTORS (ECM)**

- A. Where specified, motor shall be electronically commutated type specifically designed for the fan or pump application. The motor shall be rated for continuous operation.
- B. Motor shall be permanently lubricated with heavy-duty ball bearings to match the load and prewired to the specific voltage and phase.
- C. Internal motor circuitry shall convert AC power supplied to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by a 0-10 VDC signal, unless indicated otherwise.
- D. Motor shall be a minimum of 85% efficient at all speeds.





## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

**END OF SECTION**



## SECTION 23 05 16 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- B. ASTM A536 - Standard Specification for Ductile Iron Castings.
- C. EJMA (STDS) - EJMA Standards.
- D. FM (AG) - FM Approval Guide.
- E. ITS (DIR) - Directory of Listed Products.
- F. UL (DIR) - Online Certifications Directory.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
  - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

### PART 2 PRODUCTS

#### 2.1 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
  - 1. Flex-Hose Co., Inc.
  - 2. The Metraflex Company.
  - 3. Twin City Hose.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Single braided, stainless steel.
- D. Pressure Rating: 125 psi up to 12 inch.
- E. Maximum Service Temperature: 450 degrees F.
- F. End Connections: Flanged.
- G. Maximum offset: 3/4 inch on each side of installed center line.

#### 2.2 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
  - 1. Flex-Hose Co., Inc.
  - 2. The Metraflex Company.
  - 3. Twin City Hose.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi up to 2 inch.

- E. Maximum Service Temperature: 450 degrees F.
- F. End Connections: Flanged.
- G. Maximum offset: 3/4 inch on each side of installed center line.
- H. Application: Copper piping.

### **2.3 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE**

- A. Manufacturers:
  - 1. Flex-Hose Co., Inc.
  - 2. Metraflex Company
  - 3. Twin City Hose.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 1-3/4 inches.
- D. Maximum Extension: 1/4 inch.
- E. End Connections: Externally pressurized with flanged ends.
- F. Application: Steel piping 3 inches and under.

### **2.4 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE**

- A. Manufacturers:
  - 1. Flex-Hose Co., Inc.
  - 2. The Metraflex Company.
  - 3. Twin City Hose.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 15/16 inch.
- D. Maximum Extension: 5/16 inch.
- E. Maximum Offset: 1/8 inch.
- F. End Connections: Flanged.
- G. Accessories: Internal flow liner and external shroud.
- H. Application: Steel piping over 2 inches.

### **2.5 EXPANSION JOINTS - SINGLE SPHERE, FLEXIBLE CONNECTOR**

- A. Manufacturers:
  - 1. Flex-Hose Co. Inc.
  - 2. The Metraflex Company.
  - 3. Twin City Hose.
  - 4. Victaulic
- B. Body Construction: Nylon-reinforced rubber tube.
- C. Cover and Tube Elastomer: EPDM and EPDM.
- D. End Connections: Carbon steel flanges.
- E. Maximum Elongation: 3/8 inch.
- F. Maximum Angular Movement: 15 degrees.
- G. Accessories: Control cables.
- H. Service Rating: Up to 105 psi at 250 degrees F.

### **2.6 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID**

- A. Manufacturers:
  - 1. Flex-Hose Co. Inc..
  - 2. The Metraflex Company.

3. Twin City Hose.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
- C. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure
- D. Maximum Working Pressure: 150 psi at 800 degrees F.
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment
  1. Selected Product to Accommodate:
    - a. Compression and Expansion Axial Deflection
    - b. Angular Rotation: 15 degrees.
    - c. Force developed by 1.5 times specified maximum allowable operating pressure.
  2. Provide necessary accessories including, but not limited to, swivel joints.

## **2.7 EXPANSION JOINTS - EXTERNALLY PRESSURIZED**

- A. Manufacturers:
  1. Flex-Hose Co. Inc.
  2. The Metraflex Company; Metragator: [www.metraflex.com/#sle](http://www.metraflex.com/#sle).
  3. Twin City Hose.
- B. Bellows Type: Two-ply, single bellows constructed of 304 stainless steel.
- C. Internal Liner: Carbon steel with internal and external guides.
- D. End Connections: Class 150, carbon steel, welded flange.
- E. Maximum Axial Compression: 4 inch.
- F. Maximum Working Pressure: 150 psi at 700 degrees F.
- G. Application: Steel piping 2 inches and over.

## **2.8 GROOVED END EXPANSION JOINTS**

- A. Packless, gasketed, type with grooved end telescoping body, suitable for axial end movement to 3". 350 psi (2410 kPa). Victaulic Style 150 Mover®.
- B. Expansion joint consisting of a series of grooved end nipples joined with flexible-type couplings. Joint movement and expansion capabilities determined by number of couplings / nipples used in the joint. Victaulic Style 155.

## **2.9 ACCESSORIES**

- A. Pipe Alignment Guides:
  1. Manufacturers:
    - a. Flex-Hose Co. Inc.
    - b. The Metraflex Company.
    - c. Twin City Hose.
- B. Anchors: See details on construction plans.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.



- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

**END OF SECTION**

## SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 05 23 - General-Duty Valves for HVAC Piping.
- C. Section 23 05 53 - Identification for HVAC Piping and Equipment: Piping identification.
- D. Section 23 07 19 - HVAC Piping Insulation.

#### 1.3 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
- C. FM (AG) - FM Approval Guide.
- D. UL (DIR) - Online Certifications Directory.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
  - 1. Minimum three years experience.
  - 2. Approved by manufacturer.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.1 PIPE SLEEVES

- A. Vertical Piping:
  - 1. Sleeve Length: 1 inch above finished floor.
  - 2. Provide sealant for watertight joint.
  - 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
  - 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

- B. Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. Pipe Passing Through Below Grade Exterior Walls:
  - 1. Zinc coated or cast iron pipe.
  - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- D. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
  - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
  - 2. Connect sleeve with floor plate except in mechanical rooms.
- E. Pipe Passing Through Mechanical, Locker Room, Restroom, Laundry, and Kitchen Floors above other spaces:
  - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
  - 2. Connect sleeve with floor plate except in mechanical rooms.
- F. Clearances:
  - 1. Provide allowance for insulated piping.
  - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
  - 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.

## 2.2 PIPE-SLEEVE SEALS

- A. Manufacturers:
  - 1. Advance Products & Systems, LLC..
  - 2. GPT; an EnPro Industries Company
  - 3. Metraflex Company
- B. Modular Mechanical Sleeve-Seal:
  - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
  - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening, 20 psi.
  - 3. Size and select seal component materials in accordance with service requirements.
  - 4. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
  - 1. Provide packing and sealing compound to fill pipe to sleeve thickness.
  - 2. Combined packing and seal compound is to match partition fire-resistance hourly rating.
- D. Pipe Sleeve Material:
  - 1. Bearing Walls: Steel, cast iron, or terracotta pipe.
  - 2. Masonry Structures: Sheet metal or fiber.
- E. Wall Sleeve: Steel material with waterstop collar, and nailer end-caps.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

### 3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Structural Considerations:



1. Do not penetrate building structural members unless indicated.
- E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Seal pipe sleeve watertight with mechanically expandable chloroprene inserts with bitumen sealed metal components.
  2. Above ground Piping:
    - a. Pack solid using mineral fiber in compliance with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
  3. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 84 00 to prevent the spread of fire, smoke, and gases.
  4. Seal exterior wall sleeves watertight with mechanically expandable chloroprene inserts with mastic-sealed components.
- F. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a water-tight seal.
  6. Install in accordance with manufacturer's recommendations.
- G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.3 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION**



## SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Positive displacement meters.
- B. Pressure gauges and pressure gauge taps.
- C. Thermometers and thermometer wells.
- D. Static pressure gauges.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 09 13 - Instrumentation and Control Devices for HVAC
- B. Section 23 09 23 - Direct-Digital Control System for HVAC.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- D. Section 23 21 13 - Hydronic Piping.

#### 1.3 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks.
- B. ASME B40.100 - Pressure Gauges and Gauge Attachments.
- C. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi.
- D. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.
- E. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- F. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case.
- G. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service.
- H. AWWA C702 - Cold-Water Meters -- Compound Type.
- I. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance.
- J. IEEE 802.3 - IEEE Standard for Ethernet.
- K. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications.
- L. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks.
- M. LonMark Interoperability Guide - LonMark Application-Layer Interoperability Guide and LonMark Layer 1-6 Interoperability Guide; Version 3.4.
- N. Modbus (PS) - The Modbus Organization Communications Protocol..
- O. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
- P. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Project Record Documents: Record actual locations of components and instrumentation.

#### 1.5 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

## **PART 2 PRODUCTS**

### **2.1 POSITIVE DISPLACEMENT METERS (LIQUID)**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc.
  - 2. Venture Measurement, a Danaher Corporation Company.
- B. AWWA C700, positive displacement disc type suitable for fluid with metal alloy main case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading.
- C. Meter: Brass body turbine meter with magnetic drive register.
  - 1. Service: Cold water, 122 degrees F.
  - 2. Accuracy: 1-1/2 percent.
  - 3. Maximum Counter Reading: 10 million gallons.
  - 4. Size: 1/2 inch.

### **2.2 PRESSURE GAUGES**

- A. Manufacturers:
  - 1. Ashcroft Inc.
  - 2. Dwyer Instruments, Inc.
  - 3. Miljoco Corporation
  - 4. Trerice, H. O. Co.
  - 5. Weiss Instruments, Inc.
  - 6. Weksler Glass Thermometer Corp.
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
  - 1. Case: Cast aluminum with phosphor bronze bourdon tube.
  - 2. Window: Glass and Plastic
  - 3. Size: 4-1/2 inch diameter.
  - 4. Mid-Scale Accuracy: One percent.
  - 5. Scale: Psi and KPa.

### **2.3 PRESSURE GAUGE TAPPINGS**

- A. Ball Valve: Brass, 1/4 inch or 1/2 inch NPT for minimum 150 psi.
- B. Pulsation Damper: Pressure snubber, brass with 1/4 inch or 1/2 inch connections.

### **2.4 STEM TYPE THERMOMETERS**

- A. Manufacturers:
  - 1. Ashcroft Inc.
  - 2. Miljoco Corporation
  - 3. Trerice, H. O. Co.
  - 4. Weiss Instruments, Inc.
  - 5. Weksler Glass Thermometer Corp.
- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
  - 1. Size: 9 inch scale.
  - 2. Window: Clear Lexan.
  - 3. Stem: 3/4 inch NPT brass.
  - 4. Accuracy: 2 percent, per ASTM E77.
  - 5. Calibration: Degrees F.

## 2.5 DIAL THERMOMETERS

- A. Manufacturers:
  - 1. Ashcroft Inc.
  - 2. Miljoco Corporation
  - 3. Trerice, H. O. Co.
  - 4. Weiss Instruments, Inc.
  - 5. Weksler Glass Thermometer Corp.
- B. Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
  - 1. Size: 5 inch diameter dial.
  - 2. Lens: Clear glass.
  - 3. Accuracy: 1 percent.
  - 4. Calibration: Degrees F.

## 2.6 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

## 2.7 TEST PLUGS

- A. Manufacturers:
  - 1. Flow Design, Inc.
  - 2. Miljoco Corporation.
  - 3. Nexus Valve, Inc.
  - 4. Peterson Equipment Co.
  - 5. Watts Water Technologies.
  - 6. Weiss Instruments, LLC.
  - 7. Weksler Glass Thermometer Corp.
- B. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

## 2.8 STATIC PRESSURE GAUGES

- A. Manufacturers:
  - 1. AirGuard; Clarcor Air Filtration Products, Inc.
  - 2. Dwyer Instruments, Inc.
  - 3. H.O. Trerice Co.
  - 4. Weiss Instruments.
  - 5. Weksler Glass Thermometer Corp.
- B. 4-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

- C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe gage with shutoff valve on suction and discharge side of gage using hard pipe or tubing. **Rubber hoses are not allowed.**
- D. Install pressure gauges with pulsation dampers. Provide ball valve to isolate each gauge. Extend nipples to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometers in air duct systems on flanges.
- G. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 09 23.
- H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent to control device sockets.

**END OF SECTION**

## SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Angle valves.
- B. Globe valves.
- C. Ball valves.
- D. Butterfly valves.
- E. Check valves.
- F. Gate valves.
- G. Chainwheels.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- B. Section 23 07 19 - HVAC Piping Insulation.
- C. Section 23 21 13 - Hydronic Piping.

#### 1.3 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

#### 1.4 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End.
- H. ASME B31.9 - Building Services Piping.
- I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- J. ASTM A536 - Standard Specification for Ductile Iron Castings.
- K. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
- L. AWWA C606 - Grooved and Shouldered Joints.
- M. MSS SP-45 - Drain and Bypass Connections.

- N. MSS SP-67 - Butterfly Valves.
- O. MSS SP-68 - High Pressure Butterfly Valves with Offset Design.
- P. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.
- Q. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends.
- R. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service.
- S. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves.
- T. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
- U. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- V. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided.

### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

### 1.6 QUALITY ASSURANCE

- A. Manufacturer:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
  - 2. Protect valve parts exposed to piped medium against rust and corrosion.
  - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
  - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
  - 5. Secure check valves in either the closed position or open position.
  - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
  - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
  - 2. Avoid the use of operating handles or stems as rigging or lifting points.

## PART 2 PRODUCTS

### 2.1 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).



- B. Provide the following valves for the applications if not indicated on drawings:
1. Throttling (Hydronic): Butterfly, Ball, and Globe.
  2. Isolation (Shutoff): Butterfly, Gate, and Ball.
  3. Swing Check (Pump Outlet):
    - a. Size 2 inch and Smaller: Bronze with bronze disc.
    - b. Size 2-1/2 inch and Larger: Iron with lever and weight, lever and spring, center-guided metal, or center-guided with resilient seat.
- C. Hydronic Valves:
1. Size 2 inch and Smaller, Brass and Bronze Valves:
    - a. Threaded ends.
    - b. Ball: Full port, two piece, brass trim.
    - c. Swing Check: Bronze disc, Class.
    - d. Gate: RS, Class 125.
    - e. Globe: Bronze disc, Class 125.
  2. Size 2-1/2 inch and Larger, Iron Valves:
    - a. 2-1/2 inch to 4 inch: Flanged ends.
    - b. Ball: 2-1/2 NPS to 10 inch, Class 150.
    - c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
    - d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
    - e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 300 CWP.
    - f. Swing Check: Metal seats, Class 125.
    - g. Swing Check with Closure Control: 2-1/2 inch to 12 inch, lever and spring, Class 125.
    - h. Grooved-End Check: 3 inch to 12 inch, 300 CWP.
    - i. Center-Guided Check: Compact-wafer, metal seat, Class 125.
    - j. Plate-Type Check: Single plate, metal seat, Class 125.
    - k. Gate: OS&Y, Class 125.
    - l. Globe: Class 125.
- D. Heating Hot Water Valves:
1. Size 2 inch and Smaller, Brass and Bronze Valves:
    - a. Threaded ends.
    - b. Angle: Bronze disc, Class 125.
    - c. Ball: Full port, one piece, brass trim.
    - d. Gate: NRS, Class 125.
    - e. Globe: Bronze disc, Class 125.
  2. Size 2-1/2 inch and Larger, Iron Valves:
    - a. 2-1/2 inch to 4 inch: Threaded ends.
    - b. Ball: 2-1/2 inch to 10 inch, Class 150.
    - c. Single-Flange Butterfly: 2-1/2 inch to 12 inch, aluminum-bronze disc, EPDM seat, 200 CWP.
    - d. Single-Flange Butterfly: 14 inch to 24 inch, aluminum-bronze disc, EPDM seat, 150 CWP.
    - e. Grooved-End Butterfly: 2-1/2 inch to 12 inch, 175 CWP.
    - f. Butterfly: High performance, single flange, Class 150.
    - g. Swing Check: Metal seats, Class 125.
    - h. Swing Check: 2-1/2 inch to 12 inch, lever and spring closure control, Class 125.
    - i. Grooved-End Swing Check: 3 inch to 12 inch, 300 CWP.
    - j. Center-Guided Check: Compact-wafer, metal seat, Class 125.
    - k. Plate-Type Check: Single plate, metal seat, Class 125 .
    - l. Gate: NRS, Class 125.
    - m. Globe: 2-1/2 inch to 12 inch, Class 125.

## 2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
  - 1. Gear Actuator: Quarter-turn valves 4 inch and larger.
  - 2. Handwheel: Valves other than quarter-turn types.
  - 3. Hand Lever: Quarter-turn valves 6 inch and smaller.
  - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- D. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
  - 1. Gate Valves: Rising stem.
  - 2. Ball Valves: 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: Extended neck.
  - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Memory Stops: Fully adjustable after insulation is installed.
- F. Valve-End Connections:
  - 1. Threaded End Valves: ASME B1.20.1.
  - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
  - 3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
  - 4. Solder Joint Connections: ASME B16.18.
  - 5. Grooved End Connections: AWWA C606.
- G. General ASME Compliance:
  - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
  - 2. Building Services Piping Valves: ASME B31.9.
- H. Bronze Valves:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- I. Valve Bypass and Drain Connections: MSS SP-45.
- J. Source Limitations: Obtain each valve type from a single manufacturer.

## 2.3 BRONZE, ANGLE VALVES

- A. CWP Rating: Class 125: 200 psi and Class 150: 300 psi:
  - 1. Comply with MSS SP-80, Type 1.
  - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
  - 3. Ends: Threaded.
  - 4. Stem: Bronze.
  - 5. Disc: Bronze, PTFE, or TFE.
  - 6. Packing: Asbestos free.
  - 7. Handwheel: Bronze or aluminum.

## 2.4 BRONZE, GLOBE VALVES

- A. CWP Rating: Class 125: 200 psi:
  - 1. Comply with MSS SP-80, Type 1.
  - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
  - 3. Ends: Threaded or solder joint.
  - 4. Stem and Disc: Bronze or PTFE.
  - 5. Packing: Asbestos free.

6. Handwheel: Malleable iron.
7. Manufacturers:
  - a. Apollo Valves.
  - b. Crane; a Crane Co. brand.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Stockham; a Crane Co. brand.
  - g. WATTS.

## 2.5 BRONZE, GLOBE VALVES

- A. Ratings for Class 125 and Class 250:
  1. Class 125:
    - a. WOG Rating: 200 psi.
    - b. WSP Rating: 125 psi, saturated.
  2. Class 250: WOG Rating; 300 psi.
  3. Comply with MSS SP-80, Type 1.
  4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
  5. End Connections: Threaded or solder.
  6. Bonnet: NRS; Nonrising Stem.
  7. Nonrising Stem: Bronze.
  8. Disc: PTFE.
  9. Packing: Asbestos free.
  10. Handwheel Operator: Malleable Iron.

## 2.6 IRON, GLOBE VALVES

- A. CWP Ratings: Class 125: 200 psi and Class 250: 500 psi:
  1. Comply with MSS SP-85, Type I.
  2. Body: Gray iron; ASTM A126, with bolted bonnet.
  3. Ends: Flanged.
  4. Trim: Bronze.
  5. Packing and Gasket: Asbestos free.
  6. Operator: Handwheel or chainwheel.
  7. Manufacturers:
    - a. Apollo Valves.
    - b. Crane; a Crane Co. brand.
    - c. Hammond Valve.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; a Crane Co. brand.
    - g. WATTS.

## 2.7 BRASS, BALL VALVES

- A. Two Piece, Full Port with Brass Trim and Female Thread, Male thread, or Solder Connections:
  1. Comply with MSS SP-110.
  2. SWP Rating: 150 psi.
  3. WOG Rating: 600 psi.
  4. Vacuum Rating: 28.9 in-Hg.
  5. Body: Forged brass.
  6. Seats: PTFE.
  7. Stem: Brass.
  8. Ball: Chrome-plated brass.
  9. Manufacturers:

- a. Apollo Valves.
  - b. Hammond Valve.
  - c. Jomar Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Stockham; a Crane Co. brand.
  - g. WATTS.
- B. Two Piece, Full Port with Press Connection:
1. WOG Rating: 250 psi.
  2. Body: Forged brass.
  3. Seats: PTFE.
  4. Ball: Chrome-plated brass.
  5. Blow-out Proof Stem: Forged brass.
  6. Maximum Service Temperature: 250 degrees F.
  7. Manufacturers:
    - a. Apollo Valves.
    - b. Hammond Valve.
    - c. Jomar Valve.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; a Crane Co. brand.
    - g. WATTS.
    - h. Viega.
    - i. Victaulic

## 2.8 BRONZE, BALL VALVES

- A. General:
1. Fabricate from dezincification resistant material.
  2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Full Port with Bronze or Brass Trim:
1. Comply with MSS SP-110.
  2. WSP Rating: 150 psi.
  3. WOG Rating: 600 psi.
  4. Body: Forged bronze or dezincified-brass alloy.
  5. End Connections: Pipe thread or solder.
  6. Seats: PTFE.
  7. Stem: Bronze or brass.
  8. Ball: Chrome plated brass.
  9. Manufacturers:
    - a. Apollo Valves.
    - b. Hammond Valve.
    - c. Jomar Valve.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; a Crane Co. brand.
    - g. WATTS.

## 2.9 STAINLESS STEEL, BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
  2. WSP Rating: 150 psi.
  3. CWP Rating: 1,000 psi.

4. Vacuum Rating: 14.2 psi.
5. Body: Stainless steel.
6. Seats: PTFE.
7. Stem: Stainless steel, blowout proof.
8. Ball: Stainless steel, vented.
9. End Connections: Threaded.
10. Manufacturers:
  - a. Apollo Valves.
  - b. Hammond Valve.
  - c. Jomar Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Stockham; a Crane Co. brand.
  - g. WATTS.

## **2.10 IRON, BALL VALVES**

- A. Split Body, Full Port:
  1. Comply with MSS SP-72.
  2. CWP Rating: 200 psi.
  3. Body: ASTM A126, gray iron.
  4. Ends: Flanged.
  5. Seats: PTFE.
  6. Stem: Stainless steel.
  7. Ball: Stainless steel.
  8. Manufacturers:
    - a. Apollo Valves.
    - b. WATTS

## **2.11 IRON, GROOVED-END BALL VALVES**

- A. Class 200:
  1. CWP Rating: 600 psi.
  2. Body: Ductile iron; ASTM A536, Grade 65-45-12.
  3. Ends: Grooved.
  4. Seats: Teflon.
  5. Stem: Nickel plated carbon steel.
  6. Ball: Nickel plated carbon steel or Type 304 stainless steel.
  7. Manufacturers:
    - a. Anvil International, Inc. (ASC).
    - b. Grinnell G-Fire by Johnson Controls Company.
    - c. Hammond Valve.
    - d. NIBCO INC.
    - e. Victaulic Company
    - f. WATTS.

## **2.12 IRON, SINGLE FLANGE BUTTERFLY VALVES**

- A. Wafer Style:
  1. Comply with MSS SP-67, Type I.
  2. Lug Style, CWP Ratings:
    - a. Sizes 2 to 12 inch: 200 psi.
    - b. 250 psi Sizes 14 to 24 inch: 250 psi.
    - c. Vacuum Service: Down to 29.9 in-Hg.
  3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
  4. Stem: One or two-piece stainless steel.

5. Seat: EPDM.
6. Disc: Aluminum-bronze.
7. Manufacturers:
  - a. Apollo Valves.
  - b. Bray International, Inc.
  - c. Flo Fab Inc.
  - d. Hammond Valve.
  - e. Jomar Valve.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Stockham; a Crane Co. brand.
  - i. WATTS.

### **2.13 IRON, GROOVED-END BUTTERFLY VALVES**

- A. CWP Rating: 175 psi.
  1. Comply with MSS SP-67, Type I.
  2. CWP Ratings:
    - a. Sizes 2-1/2 to 8 inch: 300 psi.
    - b. Sizes 10 to 24 inch: 250 psi.
  3. Body: Coated ductile iron.
  4. Stem: Two-piece stainless steel.
  5. Disc: Coated ductile iron.
  6. Disc Seal: EPDM.
  7. Manufacturers:
    - a. Anvil International, Inc. (ASC).
    - b. Grinnell G-Fire by Johnson Controls Company.
    - c. Hammond Valve.
    - d. NIBCO INC.
    - e. Victaulic Company
    - f. WATTS.

### **2.14 HIGH-PERFORMANCE, SINGLE FLANGE BUTTERFLY VALVES**

- A. Lug type; Bidirectional dead end service without downstream flange:
  1. Comply with MSS SP-68.
  2. Class 150: CWP Rating: 285 psi at 100 degrees F.
  3. Body: Provide carbon steel, cast iron, ductile Iron, or stainless steel.
  4. Seat: Metal or reinforced PTFE.
  5. Offset stem: Stainless steel.
  6. Disc: Carbon steel.

### **2.15 BRONZE, SWING CHECK VALVES**

- A. Class 125:
  1. Pressure and Temperature Rating: MSS SP-80, Type 3.
  2. Design: Y-pattern, horizontal or vertical flow.
  3. WSP Rating: 200 psi.
  4. Body: Bronze, ASTM B62.
  5. End Connections: Threaded or soldered.
  6. Disc: Bronze.
  7. Manufacturers:
    - a. Apollo Valves.
    - b. Jenkins Valves; a Crane Co. brand.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.

- e. Stockham; a Crane Co. brand.
- B. Class 150:
- 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
  - 2. Design: Y-pattern, horizontal or vertical flow.
  - 3. CWP Rating: 300 psi.
  - 4. Body: Bronze, ASTM B62.
  - 5. End Connections: Threaded or soldered.
  - 6. Disc: Bronze.
  - 7. Manufacturers:
    - a. Apollo Valves.
    - b. Jenkins Valves; a Crane Co. brand.
    - c. Milwaukee Valve Company.
    - d. NIBCO INC.
    - e. Stockham; a Crane Co. brand.

## **2.16 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL**

- A. Class 125:
- 1. Comply with MSS SP-71, Type I.
  - 2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
  - 3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
  - 4. Body Design: Clear or full waterway.
  - 5. Body Material: ASTM A126, gray iron with bolted bonnet.
  - 6. Ends: Flanged.
  - 7. Trim: Bronze.
  - 8. Gasket: Asbestos free.
  - 9. Closer Control: Factory installed, exterior lever, and spring or weight.
  - 10. Manufacturers:
    - a. Apollo Valves.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company.

## **2.17 IRON, GROOVED-END SWING CHECK VALVES**

- A. Class 300:
- 1. CWP Rating: 300 psi.
  - 2. Body Material: ASTM A536, Grade 65-45-12 ductile iron.
  - 3. Seal: EPDM or Nitrile.
  - 4. Disc: Spring operated, ductile iron or stainless steel.
  - 5. Coating: Black, non-lead paint.
  - 6. Manufacturers:
    - a. Anvil International, Inc. (ASC).
    - b. Grinnell G-Fire by Johnson Controls Company.
    - c. Victaulic Company.

## **2.18 IRON, CENTER-GUIDED CHECK VALVES**

- A. Class 125, Compact-Wafer:
- 1. Comply with MSS SP-125.
  - 2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
  - 3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
  - 4. Body Material: ASTM A126, gray iron.
  - 5. Metal Seat: Bronze.
  - 6. Manufacturers:
    - a. Anvil International, Inc. (ASC)
    - b. Metraflex Company.

- c. Milwaukee Valve Company.

## 2.19 IRON, PLATE-TYPE CHECK VALVES

- A. Class 125 Dual-Plate:
  - 1. Comply with API STD 594.
  - 2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
  - 3. Sizes 14 to 24 inch: CWP Rating; 150 psi.
  - 4. Body Design: Wafer, spring-loaded plates.
  - 5. Body Material: ASTM A126, gray iron.
  - 6. Metal Seat: Bronze.
  - 7. Manufacturers:
    - a. APCO DeZurik Valve Co.
    - b. Flomatic Valves.

## 2.20 BRONZE, GATE VALVES

- A. Rising Stem (RS):
  - 1. Comply with MSS SP-80, Type I.
  - 2. Class 125: CWP Rating; 200 psi.
  - 3. Body Material: Bronze with integral seat and union-ring bonnet.
  - 4. Ends: Threaded or solder joint.
  - 5. Stem: Bronze.
  - 6. Disc: Solid wedge; bronze.
  - 7. Packing: Asbestos free.
  - 8. Handwheel: Malleable iron, bronze, or aluminum.
  - 9. Manufacturers:
    - a. Apollo Valves.
    - b. Crane Co.
    - c. Hammond Valve.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; a Crane Co. brand.
    - g. WATTS.

## 2.21 IRON, GATE VALVES

- A. NRS or OS&Y:
  - 1. Comply with MSS SP-70, Type I.
  - 2. Class 125:
    - a. Sizes 2-1/2 to 12 inch, CWP Rating; 200 psi.
    - b. Sizes 14 to 24 inch, CWP Rating; 150 psi.
  - 3. Body Material: Gray iron with bolted bonnet.
  - 4. Ends: Flanged.
  - 5. Trim: Bronze.
  - 6. Disc: Solid wedge.
  - 7. Packing and Gasket: Asbestos free.
  - 8. Manufacturers:
    - a. Apollo Valves.
    - b. Crane Co.
    - c. Hammond Valve.
    - d. Milwaukee Valve Company.
    - e. NIBCO INC.
    - f. Stockham; a Crane Co. brand.
    - g. WATTS.



## 2.22 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
  - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
  - 2. Attachment: For connection to ball, butterfly, and plug valve stems.
  - 3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
  - 4. Chain: Stainless steel. Sized to fit sprocket rim.
- B. Manufacturers:
  - 1. Babbitt Steam Specialty Co.
  - 2. Roto Hammer Industries; Rotork.
  - 3. Trumbull Industries.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

### 3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Lift Check: Install with stem plumb and vertical.
  - 2. Swing Check: Install horizontal maintaining hinge pin level.
  - 3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.
- E. Provide chainwheels on operators for valves 4 NPS and larger where located 96 inches or more above finished floor, terminating 60 inches above finished floor.

**END OF SECTION**



## SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Support and attachment components.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- K. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- M. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- N. FM (AG) - FM Approval Guide.
- O. MFMA-4 - Metal Framing Standards Publication.
- P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- Q. NFPA 101 - Life Safety Code.
- R. UL (DIR) - Online Certifications Directory.
- S. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
  1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Installer's Qualifications: Include evidence of compliance with specified requirements.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

## 1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
  1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
  2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
  3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
  4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel or stainless steel unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

- B. Prefabricated Trapeze-Framed Metal Strut Systems:
  - 1. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
  - 2. Strut Channel or Bracket Material:
    - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel or fiberglass.
  - 3. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- C. Prefabricated Trapeze-Framed Fiberglass Strut Systems:
  - 1. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
  - 2. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
- D. Strut Channels:
  - 1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
  - 2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.
- E. Channel Nuts:
  - 1. Indoor Application: Provide zinc-plated steel channel nut with epoxy plated, galvanized steel, stainless steel, or zinc finish and long, regular, or short spring.
  - 2. Provide 316 stainless steel channel nut with stainless steel finish and long, regular, or short spring.
- F. Hanger Rods:
  - 1. Threaded zinc-plated steel or galvanized steel for indoor applications and 316 stainless steel for outdoor and damp or humid applications, unless otherwise indicated.
- G. Steel Cable:
  - 1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Elgen Manufacturing Company, Inc.
    - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- H. Cable Hanging System Kits:
  - 1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation.
    - b. Ductmate Industries, Inc.
    - c. Gripple, Inc.
    - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  - 2. Provide cable-wire in bulk or precut lengths with respective cable hangers as required to hold minimum weight of 120 lb.
  - 3. Accessories: Provide brackets, clip or c-clip hangers, covers, and y-hook hangers.
- I. Thermal Insulated Pipe Supports:
  - 1. Manufacturers:
    - a. Buckaroos, Inc.
    - b. Carpenter & Paterson, Inc.
    - c. National Pipe Hanger Corporation.
    - d. Pipe Shields, Inc.
    - e. Piping Technology & Products, Inc.

- f. Value Engineered Products, Inc.
- 2. General Requirements:
  - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
  - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
  - c. Pipe supports to be provided for nominally sized, 1.1/2 to 30 inch pipes.
  - d. Insulation inserts for piping below ambient temperature to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
  - e. Insulation inserts for piping above ambient temperature to consist of calcium silicate insulation surrounded by a 360 degree, PVC jacketing.
- 3. PVC Jacket:
  - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
  - b. Minimum Service Temperature: Minus 40 degrees F.
  - c. Maximum Service Temperature: 180 degrees F.
  - d. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
  - e. Thickness: 60 mil.
  - f. Connections: Brush on welding adhesive.
- 4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.
- J. Pipe Supports:
  - 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
  - 2. Liquid Temperatures Up To 122 degrees F:
    - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
    - b. Support From Below: MSS SP-58 Types 35 through 38.
- K. Roller Chairs:
  - 1. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.
  - 2. Steel Yoke Type: MSS SP-58 type 44, vertically adjustable, nonconductive, and corrosion resistant.
  - 3. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.
- L. Pipe Stanchions:
  - 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
  - 2. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
  - 3. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- M. Beam Clamps:
  - 1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
  - 2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
  - 3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
  - 4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
  - 5. Center load Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
  - 6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
  - 7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
- N. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation over insulation.
  2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
  3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
  4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
  5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.
- O. Strut Clamps:
1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
  2. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
  3. Service Temperature Range: Minus 65 to 275 degrees F.
- P. Insulation Clamps:
1. Two bolt-type clamps designed for installation under insulation.
  2. Material: Carbon steel with epoxy copper or zinc finish.
- Q. Pipe Hangers:
1. Split Ring Hangers: Uninsulated Pipe
    - a. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
    - b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
    - c. Provide hanger rod and nuts of the same type and material for a given pipe run.
    - d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
  2. Swivel Ring Hangers, Adjustable: NPS 1/2 to NPS 2-1/2.
    - a. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
    - b. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
    - c. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
  3. Clevis Hangers, Adjustable: NPS 1/2 to NPS 30.
    - a. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
    - b. Light-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
    - c. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
    - d. Roller Hangers: MSS SP-58 Type 43, zinc-colored, epoxy plated.
    - e. Outdoor and Damp or Wet Indoor Locations: MSS SP-58 Type 9 or 10, hot-dipped galvanized or fiberglass-reinforced resin.
      - 1) Flammability: ASTM D635, ASTM E84, and UL 94.
- R. Pipe Alignment Guides:
1. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
  2. Pipe Sizes 10 inch and Larger: Roller type.
- S. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- T. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Manufacturers:
    - a. Anvil International.
    - b. B-Line, a brand of Eaton Corporation.

- c. Erico International Corporation, a brand of Pentair.
    - d. Miro Industries
    - e. PHP Systems/Design.
    - f. Unistrut, a brand of Atkore International Inc.
  2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
  3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
  5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
- U. Pipe Shields for Insulated Piping:
  1. Manufacturers:
    - a. Anvil International.
    - b. ASC Engineered Solutions
    - c. B-Line, a brand of Eaton Corporation.
    - d. Buckaroos, Inc.
    - e. National Pipe Hanger Corporation.
    - f. Pipe Shields, Inc.
    - g. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
  2. MSS SP-58 Type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel
  3. General Construction and Requirements:
    - a. Shields Material: Galvanized steel, 18 gauge, ASTM A527.
    - b. Minimum Service Temperature: Minus 40 degrees F.
    - c. Maximum Service Temperature: 178 degrees F.
    - d. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- V. Anchors and Fasteners:
  1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  4. Hollow Masonry: Use toggle bolts.
  5. Hollow Stud Walls: Use toggle bolts.
  6. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
  7. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
  8. Powder-actuated fasteners are not permitted.
  9. Hammer-driven anchors and fasteners are not permitted.
  10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Comply with MFMA-4.
    - b. Channel Material: Use galvanized steel.
    - c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
    - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
  11. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.



## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
  - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**



## SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling labels
- E. Ribbons

#### 1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials.

#### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.

### PART 2 PRODUCTS

#### 2.1 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Nameplates.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling labels, where located above lay-in ceiling.
- F. Heat Transfer Equipment: Nameplates.
- G. Instrumentation: Tags.
- H. Major Control Components: Nameplates.
- I. Piping: Pipe markers.
- J. Small-sized Equipment: Nameplates.
- K. Valves: Tags and ceiling labels where located above lay-in ceiling

#### 2.2 NAMEPLATES

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar Industries, Inc
  - 3. Craftmark Pipe Markers
  - 4. Kolbi Pipe Marker Co
  - 5. Marking Services, Inc
  - 6. Seton Identification Products, a Tricor Direct Company
- B. Description: Laminated three-layer plastic with engraved letters matching equipment mark on drawings.
- C. Letter Color: White.
- D. Letter Height: 1 inch.
- E. Background Color: Black.

- F. Plastic: Comply with ASTM D709.

## 2.3 TAGS

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar Industries, Inc
  - 3. Craftmark Pipe Markers
  - 4. Kolbi Pipe Marker Co
  - 5. Marking Services, Inc
  - 6. Seton Identification Products, a Tricor Company
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

## 2.4 PIPE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation
  - 2. Brimar Industries, Inc
  - 3. Craftmark Pipe Markers
  - 4. Kolbi Pipe Marker Co
  - 5. Seton Identification Products, a Tricor Company
- B. Color: Comply with ASME A13.1.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings indicating flow direction arrow and identification of fluid being conveyed.
- D. Color code as follows:
  - 1. Condensate: Green with white letters.
  - 2. Heating, Cooling, and Boiler Feedwater: Green with white letters.
  - 3. Natural Gas: Orange with black letters.
  - 4. Refrigerant Piping: Blue with white letters.
  - 5. Toxic and Corrosive Fluids: Orange with black letters.

## 2.5 CEILING LABELS

- A. Where equipment items are mounted mounted above ceilings, install plastic labels stuck on ceiling grid to identify the location of such equipment items with the respective equipment number or identification. Label shall be no wider than ceiling grid with the identification wording running parallel to the grid piece upon which it is attached.
- B. Description: Printed adhesive backed label
  - 1. Label and Letter Color: Black letters on white label.
  - 2. Height: 3/4 inch or width of ceiling grid.
- C. Above ceiling equipment requiring identification:
  - 1. HVAC Equipment.
  - 2. Fire Dampers and Smoke Dampers.
  - 3. Heating/Cooling Control and Isolation Valves (not directly located at equipment)

## 2.6 RIBBONS

- A. Provide brightly-colored ribbons for identification of manual balancing dampers in concealed ductwork.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- D. If piping is uninsulated and serving fluids at 120 deg F or higher provide a short section of insulation for pipe marker installation; do not apply markers directly to uninsulated pipe.
- E. Identify interior piping, concealed or exposed, with plastic tape pipe markers on piping 3/4 inch diameter and larger. Use tags on piping smaller than 3/4 inch diameter.
  - 1. Identify service, flow direction, and pressure.
  - 2. Install in clear view and align with axis of piping.
  - 3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- F. Identify all equipment (air handling units, heat transfer equipment, tanks, pumps, small equipment, etc.) with plastic nameplates. Where small devices, such as in-line pumps, do not permit a nameplate tags may be used.
- G. Identify control panels and major control components with plastic nameplates. Identify automatic controls and instruments with tags; key to control schematic.
- H. Identify valves in main and branch piping with tags.
- I. Locate ceiling labels to locate equipment, valves, or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**



## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Commissioning activities.
- E. Testing, adjusting and balancing of existing systems and equipment, where indicated

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 23 08 00 - Commissioning of HVAC.

#### 1.3 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition.
- B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods.
- C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
- D. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems.
- E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
  - 1. Submit to Architect.
  - 2. Submit to the Commissioning Authority.
  - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
  - 4. Include at least the following in the plan:
    - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    - c. Identification and types of measurement instruments to be used and their most recent calibration date.
    - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    - e. Final test report forms to be used.
    - f. Detailed step-by-step procedures for TAB work for each system and issue, including:
      - 1) Terminal flow calibration (for each terminal type).
      - 2) Diffuser proportioning.
      - 3) Branch/submain proportioning.
      - 4) Total flow calculations.
      - 5) Rechecking.

- 6) Diversity issues.
  - g. Details of how TOTAL flow will be determined; for example:
    - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
    - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
  - h. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
  - i. Confirmation of understanding of the outside air ventilation criteria under all conditions.
  - j. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
  - k. Method of checking building static and exhaust fan and/or relief damper capacity.
  - l. Time schedule for TAB work to be done in phases (by floor, etc.).
  - m. Time schedule for deferred or seasonal TAB work, if specified.
  - n. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
  - o. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to the Commissioning Authority.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
  - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
  - 3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
  - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  - 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
  - 7. Include the following on the title page of each report:
    - a. Name of Testing, Adjusting, and Balancing Agency.
    - b. Address of Testing, Adjusting, and Balancing Agency.
    - c. Telephone number of Testing, Adjusting, and Balancing Agency.
    - d. Project name.
    - e. Project location.
    - f. Project Architect.
    - g. Project Contractor.
    - h. Project altitude.
    - i. Report date.
- G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.



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

## **PART 3 EXECUTION**

### **3.1 GENERAL REQUIREMENTS**

- A. Perform total system balance in accordance with one of the following:
  - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
  - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
  - 3. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
  - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
  - 2. Having minimum of three years documented experience.
  - 3. Certified by one of the following:
    - a. AABC, Associated Air Balance Council: [www.aabc.com/#sle](http://www.aabc.com/#sle); upon completion submit AABC National Performance Guaranty.
    - b. NEBB, National Environmental Balancing Bureau: [www.nebb.org/#sle](http://www.nebb.org/#sle).
    - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: [www.tabbcertified.org/#sle](http://www.tabbcertified.org/#sle).
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

### **3.2 EXAMINATION**

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Access doors are closed and duct end caps are in place.
  - 9. Air outlets are installed and connected.
  - 10. Duct system leakage is minimized.
  - 11. Hydronic systems are flushed, filled, and vented.
  - 12. Proper strainer baskets are clean and in place.
  - 13. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

### **3.3 PREPARATION**

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

### **3.4 ADJUSTMENT TOLERANCES**

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.
- D. Minimum outdoor air: 100 percent to 110 percent

### **3.5 RECORDING AND ADJUSTING**

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. Check and adjust systems approximately six months after final acceptance and submit report.

### **3.6 AIR SYSTEM PROCEDURE**

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

### 3.7 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

### 3.8 COMMISSIONING

- A. See Sections 01 91 13 - General Commissioning Requirements and 23 08 00 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
  - 1. Air side systems.
  - 2. Water side systems.
- D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- E. Re-check minimum OA flows to the Blower coil units. Report TAB to Commissioning Authority.
  - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
  - 2. Use the same test instruments as used in the original TAB work.
  - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
  - 4. For purposes of re-check, failure is defined as follows:
    - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
    - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
    - c. Temperatures: Deviation of more than one degree F.
    - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
    - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
  - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Authority, verify that:

1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

### 3.9 SCOPE

- A. Test, adjust, and balance the following:
1. Terminal Heat Transfer Units.
  2. Air Handling Units.
  3. Fans.
  4. Air Inlets and Outlets.

### 3.10 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
1. Manufacturer.
  2. Model/Frame.
  3. HP/BHP.
  4. Phase, voltage, amperage; nameplate, actual, no load.
  5. RPM.
  6. Service factor.
  7. Starter size, rating, heater elements.
  8. Sheave Make/Size/Bore.
- B. Cooling Coils:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Air flow, design and actual.
  6. Entering air DB temperature, design and actual.
  7. Entering air WB temperature, design and actual.
  8. Leaving air DB temperature, design and actual.
  9. Leaving air WB temperature, design and actual.
  10. Water flow, design and actual.
  11. Water pressure drop, design and actual.
  12. Entering water temperature, design and actual.
  13. Leaving water temperature, design and actual.
  14. Saturated suction temperature, design and actual.
  15. Air pressure drop, design and actual.
- C. Heating Coils:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Air flow, design and actual.

6. Water flow, design and actual.
  7. Water pressure drop, design and actual.
  8. Entering water temperature, design and actual.
  9. Leaving water temperature, design and actual.
  10. Entering air temperature, design and actual.
  11. Leaving air temperature, design and actual.
  12. Air pressure drop, design and actual.
- D. Air Moving Equipment:
1. Location.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Arrangement/Class/Discharge.
  6. Air flow, specified and actual.
  7. Return air flow, specified and actual.
  8. Outside air flow, specified and actual.
  9. Total static pressure (total external), specified and actual.
  10. Inlet pressure.
  11. Discharge pressure.
  12. Sheave Make/Size/Bore.
  13. Number of Belts/Make/Size.
  14. Fan RPM.
- E. Return Air/Outside Air:
1. Identification/location.
  2. Design air flow.
  3. Actual air flow.
  4. Design return air flow.
  5. Actual return air flow.
  6. Design outside air flow.
  7. Actual outside air flow.
  8. Return air temperature.
  9. Outside air temperature.
  10. Required mixed air temperature.
  11. Actual mixed air temperature.
  12. Design outside/return air ratio.
  13. Actual outside/return air ratio.
- F. Exhaust Fans:
1. Location.
  2. Manufacturer.
  3. Model number.
  4. Serial number.
  5. Air flow, specified and actual.
  6. Total static pressure (total external), specified and actual.
  7. Inlet pressure.
  8. Discharge pressure.
  9. Sheave Make/Size/Bore.
  10. Number of Belts/Make/Size.
  11. Fan RPM.
- G. Duct Leak Tests:
1. Description of ductwork under test.
  2. Duct design operating pressure.



3. Duct design test static pressure.
  4. Duct capacity, air flow.
  5. Maximum allowable leakage duct capacity times leak factor.
  6. Test apparatus:
    - a. Blower.
    - b. Orifice, tube size.
    - c. Orifice size.
    - d. Calibrated.
  7. Test static pressure.
  8. Test orifice differential pressure.
  9. Leakage.
- H. Terminal Unit Data:
1. Manufacturer.
  2. Type, constant, variable, single, dual duct.
  3. Identification/number.
  4. Location.
  5. Model number.
  6. Size.
  7. Minimum static pressure.
  8. Minimum design air flow.
  9. Maximum design air flow.
  10. Maximum actual air flow.
  11. Inlet static pressure.

**END OF SECTION**

## SECTION 23 07 13 - DUCT INSULATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- B. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

#### 1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- E. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- F. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
- K. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
- L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum \_\_\_\_\_ years of experience and approved by manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

### 1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

## PART 2 PRODUCTS

### 2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

### 2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
  - 1. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 2. JP Lamborn Co; Thermal Sleeve MT: [www.jpflex.com/#sle](http://www.jpflex.com/#sle).
  - 3. Knauf Insulation; Performance+ Duct Wrap: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  - 4. Manson Insulation, a company of Knauf Insulation; Alley Wrap B: [www.imanson.com/#sle](http://www.imanson.com/#sle).
  - 5. Owens Corning Corporation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
  - 2. Maximum Service Temperature: 1,200 degrees F.
  - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
  - 1. Manufacturers:
  - 2. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 3. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  - 4. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Mastic:
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

### 2.3 GLASS FIBER, RIGID

- A. Manufacturer:
  - 1. Johns Manville: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 2. Knauf Insulation; Earthwool Insulation Board: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  - 3. Manson Insulation, a company of Knauf Insulation; AK Board: [www.imanson.com/#sle](http://www.imanson.com/#sle).
  - 4. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
- C. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  - 3. Secure with pressure-sensitive tape.



- D. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Protective Coating:
- F. Indoor Vapor Barrier Finish:
  - 1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
  - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

## 2.4 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
  - 1. Aeroflex USA; AEROFLEX Breathe-EZ: [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
  - 2. Armacell LLC; ArmaFlex Ultra with FlameDefense: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  - 3. K-Flex USA LLC; Insul-Sheet: [www.kflexusa.com/#sle](http://www.kflexusa.com/#sle).
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
  - 1. Minimum Service Temperature: Minus 40 degrees F.
  - 2. Maximum Service Temperature: 180 degrees F.
  - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

## 2.5 DUCT LINER

- A. Manufacturers:
  - 1. Aeroflex USA; AEROFLEX Breathe-EZ: [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
  - 2. Ductmate Industries, Inc, a DMI Company; \_\_\_\_\_: [www.ductmate.com/#sle](http://www.ductmate.com/#sle).
  - 3. Johns Manville; \_\_\_\_\_: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 4. Knauf Insulation; Performance+ Duct Liner: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  - 5. Manson Insulation, a company of Knauf Insulation; Akousti-Liner: [www.imanson.com/#sle](http://www.imanson.com/#sle).
- B. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
  - 1. Fungal Resistance: No growth when tested according to ASTM G21.
  - 2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
  - 3. Service Temperature: Up to 250 degrees F.
  - 4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
  - 5. Minimum Noise Reduction Coefficients:
    - a. 1/2 inch Thickness: 0.30.
    - b. 1 inch Thickness: 0.45.
    - c. 1-1/2 inches Thickness: 0.60.
    - d. 2 inch Thickness: 0.70.
- C. Phenolic Rigid Foam Insulation: Rigid foam board constructed from fiber-free phenolic insulation complying with ASTM C1126.
  - 1. Vapor Barrier: Faced on both sides with factory-applied aluminum foil vapor barrier.
  - 2. Minimum Operating Temperature: Capable of operating at a temperature of minus 5 degrees F.
  - 3. Maximum Operating Temperature: Capable of operating at a temperature of 175 degrees F.
  - 4. Apparent Thermal Conductivity: K-value no greater than 0.31 Btu inch/hr sq ft degrees F at 75 degrees F.

5. Mold Resistance: Resistant to spread of mold when tested according to UL 181.
  6. Rated Air Velocity: At 5,000 fpm or greater material does not show evidence of erosion when tested in accordance with UL 181.
  7. Products:
    - a. Kingspan Insulation LLC; KoolDuct Liner System: [www.kingspan.com/#sle](http://www.kingspan.com/#sle).
- D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
  1. Provide insulation with vapor barrier jackets.
  2. Finish with tape and vapor barrier jacket.
  3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
  1. Provide with or without standard vapor barrier jacket.
  2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- F. Duct and Plenum Liner Application:
  1. Adhere insulation with adhesive for 90 percent coverage.
  2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
  3. Seal and smooth joints. Seal and coat transverse joints.
  4. Seal liner surface penetrations with adhesive.
  5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

#### **3.3 SCHEDULES**

- A. Interior Concealed Supply Ducts: 1.5" Mineral Fiber Blanket
- B. Interior Concealed Return Ducts: 1.5" Mineral Fiber Blanket
- C. Interior Concealed Exhaust Ducts: 1.5" Mineral Fiber Blanket
- D. Interior Concealed Outdoor Air Ducts: 1.5" Mineral Fiber Blanket
- E. Interior Concealed Combustion Air Ducts: 1.5" Mineral Fiber Blanket
- F. All Interior Exposed Duct: 1" Duct liner as specified above.

**END OF SECTION**

## SECTION 23 07 19 - HVAC PIPING INSULATION

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jacketing and accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

#### 1.3 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- F. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- H. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- I. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- J. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- K. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- L. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications.
- M. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
- N. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- P. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.

- D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

### 1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

## PART 2 PRODUCTS

### 2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

### 2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
  - 1. JP Lamborn Co; Thermal Sleeve MT: [www.jpflex.com/#sle](http://www.jpflex.com/#sle).
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
  - 2. Maximum Service Temperature: 1,200 degrees F.
- C. Aluminum-Foil Laminate Jacket:
  - 1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- D. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  - 3. Secure with pressure-sensitive tape.
- E. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film with pressure-sensitive rubber-based adhesive.
- F. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

### 2.3 GLASS FIBER, RIGID

- A. Manufacturers:
  - 1. CertainTeed Corporation: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  - 2. Johns Manville Corporation: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 3. Knauf Insulation; Earthwool Pipe Insulation: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  - 4. Manson Insulation, a company of Knauf Insulation; Alley-K Pipe Insulation: [www.imanson.com/#sle](http://www.imanson.com/#sle).
  - 5. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 6. Owens Corning Corporation; VaporWick Pipe Insulation: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  - 1. K Value: ASTM C177, 0.24 at 75 degrees F.

2. Maximum Service Temperature: 850 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
1. K Value: ASTM C177, 0.23 at 75 degrees F.
  2. Maximum Service Temperature: 220 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
  2. Maximum Service Temperature: 650 degrees F.
  3. Maximum Moisture Absorption: 0.2 percent by volume.
- E. Aluminum-Foil Laminate Jacket:
1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- F. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- G. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- H. Vapor Barrier Lap Adhesive: Compatible with insulation.

## 2.4 CELLULAR GLASS

- A. Manufacturers:
1. Owens Corning Corporation; FOAMGLAS: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
- B. Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
  2. Service Temperature Range: From 250 degrees F to 800 degrees F.
  3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
  4. Water Absorption: 0.5 percent by volume, maximum.
  5. Density: A minimum of 6.12 pcf.
- C. Block Insulation: ASTM C552, Type I, Grade 6.
1. K Value: 0.35 at 100 degrees F.
  2. Service Temperature: 800 degrees F, maximum.
  3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
  4. Water Absorption: 0.5 percent by volume, maximum.

## 2.5 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
1. Aeroflex USA; AEROFLEX Self-Seal: [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
  2. Armacell LLC; ArmaFlex Ultra with FlameDefense: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  3. K-Flex USA LLC; Insul-Tube: [www.kflexusa.com/#sle](http://www.kflexusa.com/#sle).
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
  2. Maximum Service Temperature: 180 degrees F.
  3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

## 2.6 ACCESSORIES

- A. General Requirements:
  - 1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
  - 2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
  - 3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
  - 4. Supply materials that are asbestos free.
- B. Corrosion Inhibitors:
  - 1. Corrosion Control Gel:
    - a. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
  - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass Fiber Insulated Pipes Conveying Fluids Below Ambient Temperature:
  - 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
  - 1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
  - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
  - 1. Application: Piping 1-1/2 inches diameter or larger.
  - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  - 3. Insert location: Between support shield and piping and under the finish jacket.
  - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 84 00.



- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV-resistant finish for flexible elastomeric cellular insulation without jacketing.

### **3.3 SCHEDULE**

- A. Hydronic Systems:
  - 1. Hydronic Water Supply and Return: 1 1/2" Mineral Fiber
- B. Refrigerant Systems:
  - 1. Refrigerant Suction & Hot Gas: 1" Cellular Glass

**END OF SECTION**





## SECTION 23 08 00 - COMMISSIONING OF HVAC

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. See Section 01 91 13 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 91 13.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
  - 1. Control system.
  - 2. Major and minor equipment items.
  - 3. Piping systems and equipment.
  - 4. Ductwork and accessories.
  - 5. Terminal units.
  - 6. Variable frequency drives.
  - 7. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

#### 1.2 RELATED REQUIREMENTS

- A. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- C. Section 23 09 23 - Direct-Digital Control System for HVAC.
- D. Section 23 09 93 - Sequence of Operations for HVAC Controls.

#### 1.3 REFERENCE STANDARDS

- A. Code - Energy Code
- B. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process.

#### 1.4 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
  - 1. System name.
  - 2. List of devices.
  - 3. Step-by-step procedures for testing each controller after installation, including:
    - a. Process of verifying proper hardware and wiring installation.
    - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
    - c. Process of performing operational checks of each controlled component.



- d. Plan and process for calibrating valve and damper actuators and all sensors.
- e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
5. Description of the instrumentation required for testing.
6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
  1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
  2. Full as-built set of control drawings.
  3. Full as-built sequence of operations for each piece of equipment.
  4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
    - a. Floor.
    - b. Room number.
    - c. Room name.
    - d. Air handler unit ID.
    - e. Reference drawing number.
    - f. Air terminal unit tag ID.
    - g. Heating and/or cooling valve tag ID.
    - h. Minimum air flow rate.
    - i. Maximum air flow rate.
  5. Full print out of all schedules and set points after testing and acceptance of the system.
  6. Full as-built print out of software program.
  7. Electronic copy on disk of the entire program for this facility.
  8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
  9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
  10. Control equipment component submittals, parts lists, etc.
  11. Warranty requirements.
  12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
  13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
    - a. Sequences of operation.
    - b. Control drawings.
    - c. Points lists.
    - d. Controller and/or module data.
    - e. Thermostats and timers.
    - f. Sensors and DP switches.
    - g. Valves and valve actuators.

- h. Dampers and damper actuators.
  - i. Program setups (software program printouts).
- E. Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
- 1. Follow the recommendations of ASHRAE Guideline 1.1.
  - 2. Control system manufacturer's recommended training.
  - 3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- F. Training Manuals: Follow the training recommendations of ASHRAE Guideline 1.1.
- 1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

## **PART 2 PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with Contract Documents.

### **3.2 INSPECTING AND TESTING - GENERAL**

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Provide two-way radios for use during the testing.
- D. Valve/Damper Stroke Setup and Check:
  - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.

2. Set pump/fan to normal operating mode.
  3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
  4. Command valve/damper open; verify position is full open and adjust output signal as required.
  5. Command valve/damper to a few intermediate positions.
  6. If actual valve/damper position does not reasonably correspond or replace actuator.
  7. Closure for Heating Coil Valves - Normally Open:
    - a. Set heating setpoint 20 degrees F above room temperature.
    - b. Observe valve open.
    - c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
    - d. Restore to normal.
    - e. Set heating setpoint to 20 degrees F below room temperature.
    - f. Observe the valve close.
    - g. Restore to normal.
  8. Closure for Cooling Coil Valves - Normally Closed:
    - a. Set cooling setpoint 20 degrees F above room temperature.
    - b. Observe the valve close.
    - c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
    - d. Restore to normal.
    - e. Set cooling setpoint to 20 degrees F below room temperature.
    - f. Observe valve open.
    - g. Restore to normal.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

### 3.3 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

### 3.4 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
  - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
  - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
  - 1. Setpoint changing features and functions.
  - 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
  - 1. That all specified functions and features are set up, debugged and fully operable.
  - 2. That scheduling features are fully functional and setup, including holidays.
  - 3. That all graphic screens and value readouts are completed.
  - 4. Correct date and time setting in central computer.
  - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
  - 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
  - 7. Power failure and battery backup and power-up restart functions.
  - 8. Global commands features.
  - 9. Security and access codes.
  - 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
  - 11. O&M schedules and alarms.
  - 12. Occupancy sensors and controls.
  - 13. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

### **3.5 OPERATION AND MAINTENANCE MANUALS**

- A. See Section 01 78 00 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

### **3.6 DEMONSTRATION AND TRAINING**

- A. See Section 01 79 00 for additional requirements.



- B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned.
- E. TAB Review: Instruct Owner's personnel for minimum \_\_\_\_ hours, after completion of TAB, on the following:
  - 1. Review final TAB report, explaining the layout and meanings of each data type.
  - 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
  - 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
  - 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
  - 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. Provide the services of manufacturer representatives to assist instructors where necessary.
- G. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

**END OF SECTION**

## SECTION 23 09 13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Control panels.
- B. Control Valves:
  - 1. Ball valves with factory-mounted actuators.
  - 2. Butterfly valves with factory-mounted actuators.
  - 3. Electronic valve operators.
  - 4. Radiation valves.
- C. Pressure independent valves and actuators.
- D. Dampers.
- E. Damper Operators:
  - 1. Electric operators.
  - 2. Inlet vane operators.
- F. Humidistats:
  - 1. Room humidistats.
  - 2. Limit duct humidistats.
- G. Wall-, Surface-, and Duct-Mounted Sensors:
  - 1. Temperature sensors.
  - 2. Humidity sensors.
  - 3. IAQ (indoor air quality) sensors.
  - 4. Building static pressure transmitters.
  - 5. Room pressure monitors.
  - 6. Static air pressure sensors.
  - 7. Air pressure transmitters.
  - 8. Airflow meters; thermal dispersion.
  - 9. Damper position indicators.
  - 10. 454b refrigerant sensors.
  - 11. Nitrogen dioxide sensors.
  - 12. Carbon monoxide sensors.
  - 13. Carbon dioxide sensors.
- H. Thermostats:
  - 1. Electric thermostats.
  - 2. Freezestats.
  - 3. Line voltage thermostats.
  - 4. Room-mount thermostat accessories.
  - 5. Outdoor-reset thermostats.
  - 6. Electric high/low limit duct thermostats.
- I. Time switches.
- J. Fan and pump motor run-status monitoring.
- K. Pipe-Mounted Sensors and Transmitters:
  - 1. Temperature sensors.
  - 2. Pressure transmitters.
  - 3. Differential pressure transmitters.
  - 4. Disc flow meters.
  - 5. Fuel-gas flow meters.
  - 6. Flow switches.

7. Electromagnetic flow meter
  8. Turbine/impeller flow meters.
  9. Thermal mass flow meters.
  10. Ultrasonic flow meters.
  11. Vortex flow meters.
- L. Energy Metering:
1. Hydronic energy meters.
- M. Level Switches:
1. Conductivity Sensors:
    - a. Conductivity level probe.
  2. Float Sensors:
    - a. Level switches - horizontal.
    - b. Liquid level switch (leak resistant).
    - c. Insertion type level control.
    - d. Boiler water level control.
  3. Optical Sensors:
    - a. Optical level switch.

## 1.2 RELATED REQUIREMENTS

- A. Section 23 05 19 - Meters and Gauges for HVAC Piping: Thermometer sockets and gauge taps.
- B. Section 23 21 13 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, and gauge taps.
- C. Section 23 21 14 - Hydronic Specialties.
- D. Section 23 33 00 - Air Duct Accessories.
- E. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.
- F. Section 26 27 26 - Wiring Devices: Elevation of exposed components.

## 1.3 REFERENCE STANDARDS

- A. ANSI C12.1 - Electric Meters - Code for Electricity Metering.
- B. ANSI C12.10 - American National Standard for Physical Aspects of Watthour Meters - Safety Standard.
- C. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes.
- D. ANSI/FCI 70-2 - Control Valve Seat Leakage.
- E. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks.
- F. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- G. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case.
- H. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).
- I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- J. NEMA DC 3 - Residential Controls - Electrical Wall-Mounted Room Thermostats.
- K. NSF 61 - Drinking Water System Components - Health Effects.
- L. NSF 372 - Drinking Water System Components - Lead Content.
- M. UL 916 - Energy Management Equipment.
- N. UL 917 - Clock-Operated Switches.



#### 1.4 ADMINISTRATIVE REQUIREMENTS

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

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- E. Project Record Documents: Record actual location of control components, including panels, thermostats, and sensors.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years experience approved by manufacturer.

#### 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.1 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

#### 2.2 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- C. Provide common keying for all panels.

#### 2.3 CONTROL VALVES

- A. Performance Criteria:
  - 1. Fail positions based on system application:
    - a. Chilled Water/Glycol: Last Position
    - b. Condenser Water: Last Position
    - c. Primary Heating Water/Glycol: Normally Open (NO)
    - d. Secondary Water/Glycol: Last Position
    - e. Radiant Floor Heating Water/Glycol: Normally Closed (NC)
- B. Ball Valves with Factory-Mounted Actuators:
  - 1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc.

- b. Griswold Controls
      - c. Johnson Controls International, PLC.
      - d. Schneider Electric.
    2. Service: Use for brine (30 percent glycol), chilled water, or hot water.
    3. Flow Characteristic: Include 2-way and 3-way diverting operation.
    4. Replacements in Kind: Provide pressure-independent type.
    5. Rangeability: 500 to 1.
    6. ANSI Rating: Class 150.
    7. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
    8. Body Size:
      - a. Under 2-1/2 inches:
        - 1) Connection: NPT.
        - 2) Materials:
          - (a) Body: Brass.
          - (b) Flanges: Ductile iron.
          - (c) Ball: 300 series stainless steel.
          - (d) Stem: 300 series stainless steel.
          - (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
          - (f) Stem Seal: EPDM O-Rings.
          - (g) Flow Control Disk: Thermoplastic synthetic-resin.
      - b. 2-1/2 inches and Above:
        - 1) Connection Type: Flanged.
        - 2) Materials:
          - (a) Body: Brass.
          - (b) Flanges: Ductile iron.
          - (c) Ball: 300 series stainless steel.
          - (d) Stem: 300 series stainless steel.
          - (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
          - (f) Stem Seal: EPDM O-Rings.
          - (g) Flow Control Disk: Thermoplastic synthetic-resin.
      - c. Service Temperature:
        - 1) Fluid Side: 0 to 284 degrees F liquid or 25 psig steam.
        - 2) Ambient Side: From minus 4 to 122 degrees F.
    9. Actuator Requirements:
      - a. Assembly: Factory-mounted.
      - b. Input: 0 to 10 VDC or 4 to 20 mA configured for proportional control.
      - c. Accessories: Provide with valve position indicator and manual override.
  - C. Butterfly Valves with Factory-Mount Actuators:
    1. Manufacturers:
      - a. Belimo
      - b. Honeywell International, Inc.
      - c. Johnson Controls International, PLC.
      - d. Schneider Electric.
      - e. Siemens Building Technologies.
      - f. Keystone; Emerson Electric
    2. Iron body, bronze disc, resilient replaceable seat for service to 180 degrees F wafer or lug ends, extended neck.
    3. Hydronic Systems:
      - a. Rate for service pressure of 125 psig at 250 degrees F.
      - b. Size for 1 psig maximum pressure drop at design flow rate.
  - D. Electronic Valve Actuators:
    1. Manufacturers:

- a. Honeywell International, Inc: [buildingcontrols.honeywell.com/#sle](http://buildingcontrols.honeywell.com/#sle).
- b. Johnson Controls International, PLC: [www.johnsoncontrols.com/#sle](http://www.johnsoncontrols.com/#sle).
- c. Schneider Electric: [www.schneider-electric.us/#sle](http://www.schneider-electric.us/#sle).
2. Valves shall position control based on system type as indicated in Performance Criteria paragraphs.
3. Select operator for full shut-off at a maximum 250 psig.
4. Actuator Requirements:
  - a. Assembly: Factory-mounted.
  - b. Input: 0 to 10 VDC or 4 to 20 mA configured for proportional control.
  - c. Accessories: Provide with valve position indicator and manual override.
- E. Radiation Valves:
  1. Manufacturers:
    - a. Danfoss
    - b. Honeywell International, Inc.
    - c. Johnson Controls International, PLC.
    - d. Siemens Industry, Inc.
  2. Bronze body, bronze trim, 2 or 3 port as indicated, replaceable plugs and seats, union and threaded ends.
  3. Rate for service pressure of 125 psig at 250 degrees F.
  4. Size for 3 psig maximum pressure drop at design flow rate.
  5. Provide two-way valves with equal percentage characteristics and three-way valves with linear characteristics. Size two-way valve operators to close valves against pump shut-off head.
  6. Modulating Operators: Self-contained, linear motorized actuator with approximately 3/4 inch stroke, 60 second full travel with transformer and SPDT contacts: 24 VDC, 6 W maximum input.

## 2.4 PRESSURE INDEPENDENT VALVES AND ACTUATORS

- A. Manufacturers:
  1. Belimo
  2. Bell & Gossett
  3. Danfoss
  4. Flow Control Industries
  5. Griswold
  6. Nexus Valve, Inc.
- B. Performance:
  1. Body Pressure Rating: Minimum 225 psig
  2. Close-off pressure: Minimum 55 psig.
  3. Process Temperature Range: 32 to 200 deg F.
- C. Size 2 inch and Smaller:
  1. Provide ball style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded connections.
  2. Metal construction materials consist of bronze or brass.
  3. Nonmetal construction materials consist of Teflon, EPDM, or engineered resin.
- D. Size 2.5 inch and Larger:
  1. Provide ball, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged or grooved connections.
  2. Valve body construction materials consist of ductile iron, ASTM A395/A395M.
  3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.
- E. Actuator Requirements:

1. Assembly: Factory-mounted.
2. Input: 0 to 10 VDC or 4 to 20 mA configured for proportional control.
3. Accessories: Provide with manual override and valve position indicator.

## 2.5 DAMPERS

- A. See Section 23 33 00 for dampers and this section for actuators and operators.

## 2.6 DAMPER OPERATORS

A. General:

1. Provide actuators with torque capacity sized for minimum of 20 percent greater than maximum design stream velocity and hold tight seal against maximum system pressures.
2. Provide the following fail safe positions:
  - a. Supply Air: Last Position
  - b. Return Air: Normally Open (NO)
  - c. Outdoor Air: Normally Closed (NC)
  - d. Exhaust Air: Normally Closed (NC)
3. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
4. Provide one operator for maximum 36 sq ft damper section.

B. Electric Operators:

1. Manufacturers:
  - a. Belimo.
  - b. Honeywell International, Inc.
  - c. Johnson Controls International, PLC.
  - d. Schneider Electric.
  - e. Siemens Building Technologies.

C. Actuator Requirements:

1. Assembly: Factory-Mounted or Field-Mounted.
2. Input: 0 to 10 VDC or 4 to 20 mA configured for proportional control.
3. Accessories: Provide with manual override and damper position indicator.

D. Inlet Vane Operators:

1. High pressure with pilot positioners and sufficient force to move vanes when fan is started with vanes in closed position. Return vane operator to closed position on fan shutdown.

## 2.7 HUMIDISTATS

A. Room Humidistats:

1. Manufacturers:
  - a. Honeywell International, Inc.
  - b. Johnson Controls International, PLC.
  - c. Siemens Industry, Inc.
  - d. Schneider Electric USA, Inc
2. Wall mounted, two-position type.
3. Field Adjustable.
4. Throttling Range: Adjustable 5 percent relative humidity.
5. Operating Range: 10 to 90 percent.
6. Maximum Temperature: 135 degrees F.
7. Cover: Set point indication.
8. Switch Type: SPDT snap switch
9. Voltage: 24VAC

B. Limit Duct Humidistats:

1. Manufacturers:
  - a. Honeywell International, Inc.

- b. Johnson Controls International, PLC.
- c. Siemens Industry, Inc.
- d. Schneider Electric USA, Inc
2. Insertion, two-position type.
3. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Field adjustable
5. Throttling Range: Adjustable 5 percent relative humidity.
6. Operating Range: 15 to 95 percent.
7. Maximum Temperature: 150 degrees F.
8. Switch Type: SPDT.
9. Voltage: 24 VAC

## 2.8 WALL-, SURFACE-, AND DUCT-MOUNT SENSORS

- A. Temperature Sensors:
  1. Manufacturers:
  2. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
  3. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
  4. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
  5. Temperature Sensing Device: Compatible with project DDC controllers.
  6. Performance Characteristics:
    - a. RTD:
      - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
      - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
      - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F minimum.
      - 4) All Other Accuracy: Plus/minus 0.75 degrees F minimum.
      - 5) Range: Minus 40 degrees F through 220 degrees F minimum.
    - b. Thermistor:
      - 1) Accuracy (All): Plus/minus 0.54 degrees F minimum.
      - 2) Range: Minus 40 degrees F through 122 degrees F minimum.
      - 3) Heat Dissipation Constant: 2.7 mW per degree C.
    - c. Temperature Transmitter:
      - 1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
    - d. Sensing Range:
      - 1) Provide limited range sensors if required to sense the range expected for a respective point.
      - 2) Use RTD type sensors for extended ranges beyond minus 30 to 230 degrees F.
      - 3) Use temperature transmitters in conjunction with RTDs when RTDs are incompatible with DDC controller direct temperature input.
    - e. Wire Resistance:
      - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
      - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
    - f. Room Sensors: Locking cover matching the pneumatic thermostats used.
    - g. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
    - h. Immersion Temperature Sensors: A sensor encased in a corrosion-resistant probe with an indoor junction box service entry body.
    - i. Public Space Sensors: Stainless steel cover plate with insulated back and security screws.

- j. Insulating Bases: For thermostats located on exterior walls.
- k. Room Temperature Sensors:
  - 1) Construct for surface or wall box mounting.
  - 2) Provide the following:
    - (a) Setpoint reset slide switch with an adjustable temperature range.
    - (b) Momentary override request push button for activation of after-hours operation.
- l. Room Temperature Sensors with Integral Digital Display:
  - 1) Construct for surface or wall box.
  - 2) Provide the following capabilities:
    - (a) Indication of space temperature and setpoint(s).
    - (b) Setpoint adjustment to accommodate room setpoint.
    - (c) Manual occupancy override and indication of occupancy status.
- m. Temperature Averaging Elements:
  - 1) Use on duct sensors for ductwork 8 sq ft or larger.
  - 2) Use averaging elements where prone to stratification with sensor length 8 ft or 16 ft.
  - 3) Provide for all mixed air and heating coil discharge sensors regardless of duct size.
- n. Insertion Elements:
  - 1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches.
  - 2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches.
    - (a) Provide immersion well from same manufacturer as sensor.
    - (b) Fill thermowell with heat transfer paste before inserting sensor.
    - (c) For insulated piping, install thermowell with extension neck beyond face of insulation.
- B. Humidity Sensors, Outdoor-Mount:
  - 1. Manufacturers:
    - a. Dwyer Instruments Inc.
    - b. Johnson Controls International, PLC.
    - c. Veris Industries.
  - 2. Replaceable digitally profiled thin-film capacitive sensor encased in a weather-proof plastic or metal housing with solar shield.
  - 3. Measuring Scale: 0 to 100 percent RH, noncondensing, temperature compensated.
  - 4. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
  - 5. Accuracy: Plus/minus 1 percent between 10 to 80 percent RH linear range, NIST traceable with multi-point calibration.
  - 6. Temperature Sensor, Combined: Platinum RTD.
    - a. Transmitter: Fitted within device-interface enclosure, calibrated.
    - b. Monitoring Range: Minus 40 to 122 degrees F, adjustable.
    - c. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
    - d. Accuracy: Plus/minus two percent. Adjustable on the transmitter end.
  - 7. Service Temperature: Minus 40 to 122 degrees F.
  - 8. Service Humidity: 0 to 100 percent RH, noncondensing.
- C. Humidity Sensors, Duct-Mounted:
  - 1. Manufacturers:
    - a. Dwyer Instruments Inc.
    - b. Johnson Controls International, PLC.
    - c. Veris Industries.
    - d. Substitutions: See Section 01 60 00 - Product Requirements.

2. Replaceable digitally profiled thin-film capacitive sensor probe extended from plastic or metal housing designed for duct mounting.
  3. Measuring Scale: 0 to 100 percent RH, noncondensing, temperature compensated.
  4. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
  5. Accuracy: Plus/minus 1 percent between 10 to 80 percent RH linear range, NIST traceable with multi-point calibration.
  6. Temperature Sensor, Combined: Platinum RTD.
    - a. Transmitter: Fitted within device-interface enclosure, calibrated.
    - b. Monitoring Range: 32 to 122 degrees F, adjustable.
    - c. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
    - d. Accuracy: Plus/minus three percent. adjustable on the transmitter end.
  7. Service Temperature: Minus 40 to 122 degrees F
  8. Service Humidity: 0 to 100 percent RH, noncondensing.
- D. IAQ (Indoor Air Quality) Sensors:
1. Manufacturers:
    - a. Automated Logic.
    - b. Building Automation Products Inc.; BAPI
    - c. Honeywell International, Inc.
    - d. Vaisala.
    - e. Veris Industries.
  2. Form Factor: Surface mounted or single-gang electrical-box-mounted module made of high-impact plastic or other resilient material.
  3. Display: LCD screen.
  4. Setpoint Control: Adjust temperature and humidity.
  5. Temperature Sensor:
    - a. Solid-state, integrated circuit type, 32 to 122 deg F range.
    - b. Accuracy: Plus/minus two percent within 0.1 deg resolution.
  6. CO<sub>2</sub> (Carbon Dioxide) Monitoring Sensor:
    - a. Non-dispersive infrared (NDIR) type, 0 to 100 %RH range.
    - b. Accuracy: Plus/minus 30 ppm within three percent of measured value.
  7. VOC (Volatile Organic Compounds) Monitoring Sensor:
    - a. Solid state type, 0 to 1,000 ppb (parts per billion) scaled from 0 to 100% range.
    - b. Accuracy: Plus/minus 15 percent of measured value.
  8. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
  9. Service Temperature: 32 to 122 degrees F.
  10. Service Humidity: 0 to 90 percent RH, noncondensing.
- E. Building Static Pressure Transmitters:
1. Manufacturers:
    - a. Dwyer Instruments Inc.
    - b. Johnson Controls International, PLC.
    - c. Setra Systems, Inc.
    - d. Veris Industries.
  2. Two ports for direct or tubing connection into wall or ceiling static pressure tip, differential type with temperature compensation, scale range +/-0.01 to 2.0 in-wc positive or negative, and sensitivity of 0.0005 in-wc. Transmit electronic signal to receiver with matching scale range.
  3. Bi-directional or Unidirectional with ranges not exceeding 150 percent of maximum expected input.
  4. Output:3-wire 0 to 10 vdc with power at 12 to 28 vdc or 2-wire 4-20ma
- F. Room Pressure Monitors / Controllers:
1. Manufacturers:
    - a. Dwyer Instruments Inc.

- b. Setra Systems, Inc.
    - c. Veris Industries.
  2. Type: Externally powered, remote differential pressure transmitter interconnected via tubing or cables to pick-up sensors located inside wall-section fitted module(s).
  3. Transmitter: Five percent accuracy, adjustable zero and span, 100 to 1 turndown, 0.1 percent of calibrated span linearity, 30 to 50 millisecond response time, minimum overpressure of 150 percent over highest range value, alphanumeric indicating display, wired or wireless connectivity for configuration, and terminal strip within enclosed electronic components.
  4. Differential Pressure Monitoring Range: 0 to 0.05 in-wc, bidirectional.
  5. BAS, SCADA, or other Integrated Automation System Output: Two-wire, 4 to 20 mA.
- G. Static-Air Pressure Sensors:
  1. Manufacturers:
    - a. Dwyer Instruments Inc.
    - b. Johnson Controls International, PLC.
    - c. Veris Industries.
  2. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
  3. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
  4. Accuracy: One percent of full scale with repeatability 0.3 percent.
  5. Output: 3-wire 0 to 10 vdc with power at 12 to 28 vdc or 2-wire 4-20ma
- H. Air Pressure Transmitters:
  1. Manufacturers:
    - a. Setra Systems, Inc.
    - b. Veris Industries.
  2. General: Provide dry air media, differential pressure transducers to monitor duct pressure.
  3. Display: Signed 3-1/2 digit LCD, indicates pressure with over-range indicator.
  4. Accuracy: Plus/minus 1 percent full scale of range with combined linearity and hysteresis.
  5. Zero Adjust: Pushbutton auto-zero and digital input using 2-position terminal block.
  6. Measuring Range: 1 to 10 in-wc, unidirectional or bidirectional.
  7. Hardwired Output: 3-wire, 0 to 5 V or 0 to 10V, field selectable.
  8. Service Temperature: Zero to 150 degrees F.
- I. Airflow Meters; Thermal Dispersion:
  1. Manufacturers:
    - a. Air Monitor, a brand of Onicon, Inc.
    - b. Ebtron, Inc.
    - c. Ruskin Company.
  2. Configuration: Duct or plenum inserted assembly using up to eight water-resistant thermal dispersion sensors per metal probe wired into external access box holding self-diagnosing sensor interface electronics with respective field wire and cable landing terminals.
  3. Provide thermal dispersion flow meters complete with matched transducers, self aligning installation hardware, and transducer cables.
  4. Optimize thermal dispersion transducer for the specific duct or pipe and process conditions for the application.
  5. Signal Monitoring Range:
    - a. Air Velocity: 0 to 5,000 fpm, bidirectional converted to airflow using section area and air velocity from listed range.
    - b. Temperature: Minus 20 to 120 degrees F.
    - c. Humidity: 5 to 95 percent RH, noncondensing.
    - d. Enthalpy: Calculate using temperature and humidity signal.
  6. Accuracy: Plus or minus 2 percent, NIST with a plus or minus 0.25 percent repeatability over listed range. Include means to zero, adjust, and calibrate outputs.



7. Access Box: NEMA 250, Type 1 with hinged cover housing and cable access ports.
  8. Interface: Fitted with 16-character, 2-line, backlit, alphanumeric display and labeled pad-type surface membrane buttons.
  9. Outputs: Two-wire, 4 to 20 mA, for each measured signal, configurable.
  10. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
- J. Airflow Measurement Array (AFMA):
1. Manufacturers:
    - a. Air Monitor, a brand of Onicon, Inc.
    - b. Ebtron, Inc.
    - c. Ruskin Company.
  2. Electronic:
    - a. Each electronic AFMA to consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type.
    - b. Sensing Elements: Distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the manufacturer.
    - c. Electronic AFMA: Accuracy of plus/minus 5 percent over a range of 125 to 5,000 fpm and temperature compensated output over a range of 32 to 212 degrees F.
    - d. Fan Inlet Measurement Devices: Refer to drawings and/or equipment schedules.
  3. Airflow Straighteners:
    - a. Provide AFMA with airflow straightener(s) when required by installation instructions.
    - b. In the absence of published documentation, provide airflow straighteners if there is duct obstruction within 5 duct diameters upstream of the AFMA.
    - c. Straightener: Contained inside a flanged sheet metal casing, with the AFMA located as specified according to the published recommendations of the AFMA manufacturer.
    - d. Construction to consist of 0.125 inch aluminum honeycomb with the straightener depth not less than 1.5 inches.
  4. Outdoor Air Temperature: In outside air measurement or in low-temperature air delivery applications, provide an AFMA certified by the manufacturer to be accurate as specified over a temperature range of minus 20 to 120 degrees F.
  5. Airflow Resistance:
    - a. Resistance to Airflow Through the AFMA and the Airflow Straightener: Not to exceed 0.085 in-wc at an airflow velocity of 2,000 fpm.
    - b. AFMA Construction: Suitable for operation at airflow rates of up to 5,000 fpm over a temperature range of 40 to 120 degrees F.
- K. Damper Position Indicators: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 to 100 percent damper travel.
- L. R454B Refrigerant Sensors:
1. Manufacturers:
    - a. Bacharach Inc, a company of MSA Safety, Inc.
    - b. Emerson Climate Technologies
    - c. Honeywell
    - d. Trane
  2. Gas sensing module that holds fixed or replaceable refrigerant gas-sensor cartridge.
  3. Form Factor: IEC 60529, IP20 enclosure, single-gang electrical box mounted.
  4. Electromechanical sensor with 0 to 2,000 ppm measurement range.
  5. Accuracy: Plus/minus two percent of range with 1 ppm resolution.
  6. Hardwired Output: Three-wire, 4 to 20 mA, loop powered.
  7. Alarm: Audible/visual alarm and auxiliary dry contact relay driven by setpoint adjustable between 100 to 1000 ppm.
- M. Nitrogen Dioxide Sensors:
1. Manufacturers:

- a. Honeywell.
  - b. Monoxivent.
  - c. MSA Instrument Division.
  - d. RKI Instruments.
  - e. Sensidyne.
  2. Gas sensing module that holds fixed or replaceable nitrogen dioxide gas-sensor cartridge.
  3. Form Factor: IEC 60529, IP20 enclosure, single-gang electrical box mounted.
  4. Electromechanical sensor with 0 to 15 ppm measurement range.
  5. Accuracy: Plus/minus Five percent of range with 0.1 ppm resolution.
  6. Hardwired Output: Three-wire, 4 to 20 mA, loop powered.
  7. Alarm: Auxiliary dry contact relay driven by setpoint adjustable between 1 to 180 ppm.
- N. Carbon Monoxide Sensors:
1. Manufacturers:
    - a. Honeywell.
    - b. Monoxivent.
    - c. MSA Instrument Division.
    - d. RKI Instruments.
    - e. Sensidyne.
  2. Gas sensing module that holds fixed or replaceable carbon monoxide gas-sensor cartridge.
  3. Form Factor: IEC 60529, IP20 enclosure, single-gang electrical box mounted.
  4. Electromechanical sensor with 0 to 500 ppm measurement range.
  5. Accuracy: Plus/minus Five percent of range with 1 ppm resolution.
  6. Hardwired Output: Three-wire, 4 to 20 mA, loop powered.
  7. Alarm: Auxiliary dry contact relay driven by setpoint adjustable between 25 to 180 ppm.
  8. Combined Nitrogen (N<sub>2</sub>) Sensor:
    - a. Electromechanical sensor with 0 to 20 ppm measurement range.
    - b. Accuracy: Plus/minus five percent of range with 0.1 ppm resolution.
    - c. Hardwired Output: Three-wire, 4 to 20 mA, loop powered.
    - d. Alarm: Auxiliary dry contact relay driven by setpoint adjustable between 1 to 3 ppm.
- O. Carbon Dioxide Sensors, Duct and Wall:
1. Manufacturers:
    - a. Building Automation Products Inc.; BAPI.
    - b. Telaire; a brand of Amphenol Thermometrics Inc.
    - c. Vaisala.
    - d. Veris Industries.
  2. General: Provide nondispersive infrared (NDIR), diffusion sampling CO<sub>2</sub> sensors with integral transducers and linear output.
  3. Air Temperature: Range of 32 to 122 degrees F.
  4. Relative Humidity: Range of 0 to 95 percent (noncondensing).
  5. Calibration Characteristics:
    - a. Automatically compensating algorithm for sensor drift due to sensor degradation.
    - b. Maximum Drift: 2 percent.
    - c. User calibratable with a minimum calibration interval of 5 years.
  6. Construction:
    - a. Sensor Chamber: Noncorrosive material for neutral effect on carbon dioxide sample.
    - b. Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
    - c. Housing: High impact plastic.
  7. Temperature Sensor: Solid state, integrated circuit; Accuracy: Plus/minus 1 degree F; Resolution: 0.2 degrees F; Output Range: 50 to 95 degrees F.

## 2.9 THERMOSTATS

- A. Electric Thermostats:
  - 1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.
  - 2. Service: Cooling and heating.
  - 3. Covers: Locking with set point adjustment and setpoint indication, with thermometer.
- B. Freezestats:
  - 1. Configuration: Vapor-filled capillary.
  - 2. Probe Sensing Length: 20 feet.
  - 3. Setpoint Adjust Control: Screw with manual reset switch.
  - 4. Switch Type: SPDT, snap-action, form C in dust-protected enclosure.
  - 5. Mounting: Locate on pre-heating/heating coil intake side.
  - 6. Field Interface: Connect load line-voltage to vfd/vsd (variable frequency drive/variable speed drive).
  - 7. Electrical Rating: Non-inductive, 125 VA at 125 to 240 VAC.
- C. Line Voltage Thermostats:
  - 1. Manufacturers:
    - a. Honeywell International, Inc.
    - b. Johnson Controls International, PLC.
    - c. Siemens Industry, Inc.
    - d. Trane
  - 2. Dead Band: Maximum 2 degrees F.
  - 3. Cover: Locking with set point adjustment and setpoint indication, with thermometer.
  - 4. Rating: Motor load.
- D. Room-Mounted Thermostat Accessories:
  - 1. Thermostat Covers: Brushed aluminum.
  - 2. Insulating Bases: For thermostats located on exterior walls.
- E. Outdoor Reset Thermostats:
  - 1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
  - 2. Scale range: Minus 10 to 70 degrees F.
- F. Electric High/Low Limit Duct Thermostats:
  - 1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is above, equal to, or below setpoint,
  - 2. Bulb length: Minimum 20 feet.
  - 3. Provide one thermostat for every 20 sq ft of coil surface.

## 2.10 TIME SWITCHES

- A. Manufacturers:
  - 1. Intermatic, Inc.
  - 2. Tork, a division of NSI Industries LLC.
- B. Digital Electronic Time Switches:
  - 1. Description: Factory-assembled, solid-state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
  - 2. Program Capability:
    - a. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
  - 3. Schedule Capacity: Not less than 16 programmable on/off operations.
  - 4. Provide automatic daylight savings time and leap year compensation.
  - 5. Provide power outage backup to retain programming and maintain clock.

6. Manual Override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
7. Provide remote photocell input with light level adjustment.
8. Input Supply Voltage: 120 VAC unless otherwise indicated.
9. Output Switch Configuration: SPST dry, unpowered, maintained contacts.
10. Output Switch Contact Ratings: As required to control the load indicated on drawings.
11. Provide lockable enclosure; environmental type complying with NEMA 250 as specified for the following installation locations:

## 2.11 FAN AND PUMP MOTOR RUN-STATUS MONITORING

- A. Current Switches:
  1. Manufacturers:
    - a. Automation Components, Inc.
    - b. Functional Devices, Inc.
    - c. Schneider Electric.
  2. Solid Core: 2-state, On/Off digital output of motor status with adjustable trip point to detect belt loss or mechanical failure and built-in pilot duty relay.
  3. Split Core: 2-state, On/Off digital output of inverter-duty motor status with adjustable trip point to detect belt loss or mechanical failure and built-in pilot duty relay.
  4. Maximum AC Current Monitoring Value: As indicated on drawings.
- B. Differential Pressure Switches:
  1. Manufacturers:
    - a. Dwyer Instruments Inc.
    - b. Honeywell International, Inc.
    - c. Johnson Controls International, PLC.
    - d. Veris Industries.
  2. Fan Status: Select for adjustable range between 0 to 5 in-wc across fan discharge and external or fan inlet. Include static pressure tips.
  3. Pump Status: Select for adjustable range between 8 to 60 psi across pump discharge and suction sides. Include static pressure tips and 3-way valve manifold.
  4. Air Duct Pressure High Limit: Select for adjustable range between 0 to 10 in-wc (positive pressure port) in supply air duct. Include static pressure tips.
  5. Air Duct Pressure Low Limit: Select for adjustable range between 0 to 5 in-wc (negative pressure port) in mixed air duct. Include static pressure tips.

## 2.12 PIPE-MOUNTED SENSORS AND TRANSMITTERS

- A. Temperature Sensors:
  1. Pipe-mounted temperature probe tied to weather-resistant enclosure for direct insertion into compatible liquids or gases or inserted into intermediary thermal grease-filled pipe-well compatible with interfaced fluid.
  2. Sensor Type: 1,000 ohm Platinum RTD.
  3. Transmitter: Fitted within probe-interface enclosure, calibrated.
    - a. Monitoring Range: Minus 40 to 122 degrees F, adjustable.
    - b. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
    - c. Accuracy: Plus/minus two percent. adjustable on the transmitter end.
  4. Accessories: Provide downstream PT test plug and brass pipe-well.
- B. Liquid Gage Pressure Transmitters:
  1. Manufacturers:
    - a. Dwyer Instruments Inc.
    - b. Setra Systems, Inc.
    - c. Veris Industries.
  2. Self-contained indicating transducer for monitoring of pneumatic, gas, liquid, or steam service with proportional range scaled over selected electronic output.

3. Service Monitoring Range: 0 to 250 psig.
  4. Wetted Material: Brass for general service or stainless steel for steam and corrosive.
  5. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
  6. Accessories: Provide gauge-port plug, isolation ball valve, and snubber.
- C. Liquid Differential Pressure Transmitters:
1. Manufacturers:
    - a. Dwyer Instruments, Inc.
    - b. Endress & Hauser
    - c. Rosemount
    - d. Foxboro
  2. General: Provide wet media differential pressure transducers with 6 ft (1.83 m) armored cable, to allow local or remote pressure sensing capability using existing plumbing runs.
    - a. Output: 3-wire transmitter; 4 to 20 mA, 0 to 5V, or 0 to 10V, selectable,
    - b. Sensor:
      - 1) Media Compatibility: 17 to 4 PH stainless steel.
      - 2) Status Indication: Dual color LED.
      - 3) Proof Pressure: 2x max. F.S. range.
      - 4) Burst Pressure: 5x max. F.S. range.
      - 5) Accuracy at 77 degrees F for less than or equal 20 ft:
        - (a) Ranges A and B: Plus/minus 1 percent F.S. typical.
        - (b) Range C: Plus/minus 1.5 percent F.S. typical.
        - (c) Range D: Plus/minus 2 percent F.S. typical.
      - 6) Surge Damping: Electronic; 1 second averaging.
      - 7) Long Term Stability: Plus/minus 0.25 percent.
    - c. Pressure Ranges:
      - 1) 0 psi to 50 psi (Gauge): 5 psid/10 psid/25 psid/50 psid (pressure differential).
      - 2) 0 psi to 100 psi (Gauge): 10 psid/20 psid/50 psid/100 psid (pressure differential).
      - 3) 0 psi to 250 psi (Gauge): 25 psid/50 psid/125 psid/250 psid (pressure differential).
    - d. Operating Conditions:
      - 1) Sensor Operating Range: Minus 4 to 185 degrees F.
    - e. Enclosure: NEMA 250, Type 4.
- D. Positive Displacement Volume Meters:
1. Manufacturers:
    - a. Dwyer Instruments, Inc.
    - b. Sensus, a Xylem brand.
    - c. Veris Industries.
    - d. Zenner USA.
  2. Meter: Bronze body with threaded or flanged connection as required for the application.
  3. Utility Connection Size: 1 inch NPT female.
  4. Lead-free bronze alloy case and cap with hermetically-sealed mechanical register.
  5. Direct reading of gerotor, nutating disc, or vane displacement type.
  6. Top-mounted indicating six-digit mechanical counter register with nonresettable totalizer.
  7. Indicate metered volume in gallons with sweep-hand dial show 0.25 unit increments.
  8. Maximum Pressure Drop: 5 psi.
  9. Hardwired Output: Reed switch adapter for AMR pulse (binary) output device hermetically sealed interface activated by magnets fixed on counter gears unless built into the meter.
  10. Output Accuracy: Plus/minus 2 percent percent of the flow range.
  11. Pressure and Temperature: Up to 150 psi and 100 degrees F.
  12. AWWA C700, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

- E. Fuel-Gas Flow Meters:
  - 1. Manufacturers:
    - a. Badger Meter, Inc.
    - b. Niagara Meters.
    - c. Sensus, a Xylem brand.
  - 2. Furnish positive displacement meter for metering up to 2,500 Std cfh natural or propane gas supply rated for scheduled flow rate at service pressure and temperature.
  - 3. Minimum Turndown Ratio: 10 to 1 with plus/minus 1 percent actual flow accuracy.
  - 4. Provide meter index with direct reading mechanical totalizing register and impulse dry contact output for remote monitoring.
  - 5. Output: Pulse with minimum resolution of 100 cu ft per pulse without exceeding 15 pulses per sec at design flow. Field adjustment or calibration not required.
- F. Flow Switches:
  - 1. Manufacturers:
    - a. Dwyer Instruments, Inc.
    - b. Honeywell International, Inc.
    - c. Johnson Controls International, PLC.
    - d. Siemens Industry, Inc.
  - 2. Repetitive Accuracy: Plus/minus 10 percent of actual flow setting.
  - 3. Switch Actuation: Adjustable over the operating range and sized for the application, such that the setpoint is between 25 and 75 percent of the full range.
  - 4. Provide Form C snap-action contacts, rated for the application.
  - 5. Furnish nonflexible paddle with magnetically actuated contacts, rated for service at a pressure greater than the installed conditions.
- G. Electromagnetic Flow Meters:
  - 1. Manufacturers:
    - a. Foxboro, a brand of Schneider Electric.
    - b. Onicon, Inc.
    - c. Veris Industries.
  - 2. Insertion Type: Include ball valve and threadolet.
  - 3. Conductive Liquid Flow Capacity Range: As indicated on drawings.
  - 4. Construction: Stainless steel or aluminum sensor integral to NEMA 250 Type 4 or 4X stainless steel or aluminum enclosure with numeric display for consumption reading.
  - 5. Liquid Conductivity: 5 mS/cm, minimum.
  - 6. Accuracy: 0.02 percent of value applied to manufacturer specified velocity range.
  - 7. Hardwired Output: Two-wire, 0 to 10 VDC, non-loop powered.
  - 8. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
  - 9. Service Pressure and Temperature: Up to 400 psi and 15 to 250 degrees F liquid side, 150 degrees F ambient.
- H. Turbine Flow Meters:
  - 1. Manufacturers:
    - a. Onicon, Inc.
    - b. Veris Industries.
  - 2. Insertion Type: Provide for 4 inch pipe with ball valve and threadolet.
  - 3. Flow Capacity Range: As indicated on drawings.
  - 4. Stainless steel case, polymer-based cap, test port, and hermetically sealed register with low flow indicator.
  - 5. Pressure and Temperature: Up to 175 psi and 120 degrees F.
- I. Thermal Mass Flow Meters:
  - 1. Manufacturers:
    - a. Fox Thermal Instruments, Inc.

- b. Onicon, Inc.
  - c. Sierra Instruments, Inc.
  2. Insertion Type: Include interfacing ball valve and threadolet.
  3. Flow Capacity Range: As indicated on drawings.
  4. Construction: Stainless steel or aluminum sensor with integral NEMA 250 Type 4 or 4X stainless steel or aluminum enclosure to hold thermal mass sensor and circuits with numeric display for consumption reading.
  5. Accuracy: Two percent over measured flow range, adjustable.
  6. Output: Two-wire, 0 to 10 VDC non-loop powered.
  7. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
  8. Service Pressure and Temperature: Up to 300 psi and minus 40 to 250 degrees F gas side, 150 degrees F ambient.
- J. Ultrasonic Water Flow Meters:
1. Manufacturers:
    - a. Onicon, Inc.
    - b. Rosemount, a brand of Emerson Electric Co.
    - c. Sierra Instruments, Inc.
    - d. Veris Industries.
  2. Inline Type:
    - a. Copper, stainless steel, or aluminum pipe segment with wetted transducing sensors for 2-1/2 inch threaded pipe.
    - b. Accuracy: One percent of value applied to manufacturer specified velocity range.
    - c. Service Pressure and Temperature: Up to 400 psi and 32 to 250 degrees F liquid side, 130 degrees F ambient.
  3. Construction: NEMA 250 Type 4 or 4X enclosure for electronics circuitry with backlit numeric display for consumption reading.
  4. Hardwired Output: Two-wire, 0 to 10 VDC, non-loop powered.
  5. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
- K. Vortex Shedding Flow Meters:
1. Vortex shedding flow meter with integral piezoelectric and pressure sensors.
  2. Media: Medium-temperature hot water with flow capacity range as indicated on drawings.
  3. Accuracy: Liquids; plus/minus 0.7 percent of volumetric flow rate reading over listed range.
  4. Construction: Stainless steel sensor linked to integral NEMA 250 Type 4 or 4X stainless steel or aluminum enclosure with membrane buttons and numeric display for demand and consumption readings.
  5. Hardwired Output: Two-wire, 4 to 20 mA, non-loop powered.
  6. Service Pressure and Temperature: Up to 300 psi and minus 330 to 500 degrees F liquid side, minus 40 to 185 degrees F ambient.

## 2.13 ENERGY METERING

- A. Hydronic Energy Meters:
1. Manufacturers:
    - a. Cadillac Meter a brand of Central Station Steam Co.
    - b. Onicon, Inc.
    - c. Veris Industries.
  2. LCD-indicating Btu/h energy meter with wall-mounted hardware capable of being installed remotely for direct connection into field-mounted compatible flow meter and temperature sensors or probes for supply and return sides.
  3. Factory configured to dynamically monitor, calculate, and output energy demand based on user configured field setting via the front panel keypad or computer interface.
  4. Integral transmitter to provide a linear analog or configurable pulse output signal representing the energy rate.

5. Software Outputs: Energy demand, energy consumption, flow rate, supply temperature, return temperature, and temperature difference.
  6. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.
- B. Power Metering and Sub-metering:
1. Digital Register:
    - a. ANSI C12.1 and ANSI C12.20, accuracy class of 0.5 power usage (kWh) meter.
    - b. Provide meter socket in accordance with ANSI C12.10.
    - c. Current rating not to exceed two amperes, voltage not to exceed 500 V, V/A combinations not to exceed 100 V/A, life rating of one billion operations.
  2. Usage (kWh) and Demand (kW) Register:
    - a. Provide current sensor assembly for three-phase circuits as indicated on drawings.
    - b. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.

## 2.14 LEVEL SWITCHES

- A. Conductivity Sensors:
1. Conductivity Level Probe:
    - a. Wetted Materials:
      - 1) Probe End: 430 Stainless Steel.
      - 2) Insulator: Ceramic.
      - 3) Fitting: Nickel plated iron.
      - 4) Seal: Silicone.
      - 5) Temperature Limits: 392 degrees F.
      - 6) Pressure Limits: 87 psi.
      - 7) Electrical Connection: Snap-snap type post.
      - 8) Process Connection: 1/2 inch NPT.
      - 9) Mounting: Threaded port, any orientation.
- B. Float Sensors:
1. Level Switches - Horizontal:
    - a. Service: Compatible liquids.
    - b. Wetted Materials: Polypropylene.
    - c. Temperature Limit:
      - 1) Minus 4 to 257 degrees F.
    - d. Pressure Limit: 218 psi.
    - e. Enclosure Rating: General purpose.
    - f. Switch Type: Hermetically sealed reed switch, reversible for NO or NC.
    - g. Electrical Rating: 20 VA: 0.17 A at 120 VAC.
    - h. Electrical Connection: 22 AWG (0.644 mm), 11.811 inches (300 mm) long.
    - i. Wire Leads:
      - 1) 22 AWG (0.644 mm) by 24 inches (61 cm).
    - j. Mounting Orientation: Vertical.
    - k. Mounting Connection: 1/8 inch male NPT.
    - l. Specific Gravity: 0.65.
  2. Liquid Level Switch (Leak Resistant):
    - a. Wetted Materials:
      - 1) Float and Body: Polyphenylene sulfide (PPS).
      - 2) Pin and Spring: 316 stainless steel.
      - 3) Magnet: Ceramic 8.
    - b. Temperature Limit: 212 degrees F.
    - c. Pressure Limit: 150 psi.
    - d. Enclosure Rating: General purpose.
    - e. Switch Type: SPDT snap switch.



- f. Electrical Rating: 5 amp at 125/250 VAC.
- 3. Insertion Type Level Control:
  - a. Wetted Materials:
    - 1) Chamber: Cast iron.
    - 2) Float and Trim: 316 stainless steel.
  - b. Temperature Limit:
    - 1) Ambient Temperature: 212 degrees F.
    - 2) Process Temperature: 425 degrees F.
  - c. Switch Type: Mercury.
  - d. Electrical Rating:
    - 1) Mercury Contacts:
      - (a) AC Current:
        - (1) 120 VOLT: 4 A.
  - e. Wiring Connection: Terminal board.
  - f. Enclosure: Painted steel.
- 4. Boiler Water Level Control:
  - a. Wetted Materials:
    - 1) Body: Cast iron.
    - 2) Float: 304 stainless steel.
    - 3) Trim and Packing Gland: Brass.
    - 4) Packing: Carbon.
    - 5) Body Gasket: Carbon.
  - b. Temperature Limit:
    - 1) Ambient Temperature: 212 degrees F.
    - 2) Process Temperature: 365 degrees F.
  - c. Pressure Limit: 150 psi.
  - d. Enclosure Rating: Weatherproof.
  - e. Switch Type: Mercury.
  - f. Electrical Rating:
    - 1) Mercury Switch: 4 A at 120 VAC/DC.
  - g. Electrical Connection: Screw terminal.
  - h. Conduit Connection: 7/8 inch hole for 1/2 inch conduit.
  - i. Process Connection: 1 inch female NPT.
  - j. Mounting Orientation: Vertical.
  - k. Deadband: Approximately 1-1/2 inch.
  - l. Manual reset.
- C. Optical Sensors:
  - 1. Optical Level Switch:
    - a. Wetted Materials: 316 stainless steel/polysulfone.
    - b. Temperature Limit:
      - 1) Process: 200 degrees F.
    - c. Pressure Limit: 1000 psi.
    - d. Repeatability: Plus/minus 0.02 inches.
    - e. Switch Type: NPN open collector.
    - f. Power Requirements: 10 to 28 VDC.
    - g. Output Signal:
      - 1) V out (maximum): 28 VDC.
    - h. Current Consumption: 35 mA (maximum).
    - i. Electrical Connection: 38 inches 3 conductor cable, 22 AWG wire.
    - j. Process Connection: 1/2 inch male NPT.
    - k. Mounting Orientation: Can be mounted in any position.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Beginning of installation means installer accepts existing conditions.
- C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- D. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Corrosive Environments: Use products that are suitable for environment to which they will be subjected. Conduit, tubing, and enclosures to be minimum 316L stainless steel with an enclosure rating of NEMA 250, 4X.
- C. Check and verify location of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Locate 48 inches above floor. Align with lighting switches; see Section 26 27 26.
- D. Mount freeze protection thermostats using flanges and element holders.
- E. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- F. Provide separable sockets for liquids and flanges for air bulb elements.
- G. Provide guards on thermostats in entrances and public areas.
- H. Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- I. Provide mixing dampers of opposed or parallel blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors.
- J. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- K. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- L. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- M. Provide conduit and electrical wiring in accordance with Section 26 05 83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- N. Provide Air Duct Low Pressure Limit Switch in Air Handling Units with decoupled outside air and return air dampers.

### **3.3 SCHEDULES**

- A. Control Valve Schedule
  - 1. Drawing Code
  - 2. Valve Size
  - 3. Flow and Target Delta-P
  - 4. Valve CV and Actual Delta-P
  - 5. Normal Position



- B. Control Damper Schedule
  - 1. Drawing Code
  - 2. Height
  - 3. Width
  - 4. Airflow
  - 5. Air Pressure Drop
  - 6. Actuator Size

**END OF SECTION**



## SECTION 23 21 13 - HYDRONIC PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Condenser water piping, buried.
- D. Condenser water piping, above grade.
- E. Equipment drains and overflows.
- F. Pipe hangers and supports.
- G. Unions, flanges, mechanical couplings, and dielectric connections.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 91 23 - Interior Painting.
- C. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- D. Section 23 05 23 - General-Duty Valves for HVAC Piping.
- E. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- F. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- G. Section 23 07 19 - HVAC Piping Insulation.
- H. Section 23 21 14 - Hydronic Specialties.

#### 1.3 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- F. ASME B31.9 - Building Services Piping.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- H. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- K. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
- L. ASTM A536 - Standard Specification for Ductile Iron Castings.
- M. ASTM B32 - Standard Specification for Solder Metal.
- N. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.

- O. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- P. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- Q. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- R. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- S. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- T. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- U. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- V. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
- W. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
- X. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- Y. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- Z. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- AA. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- BB. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing.
- CC. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- DD. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- EE. ASTM F2389 - Standard Specification for Pressure-Rated Polypropylene (PP) Piping Systems.
- FF. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- GG. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe.
- HH. AWWA C606 - Grooved and Shouldered Joints.
- II. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Product Data:
  - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
  - 2. Provide manufacturers catalog information.
  - 3. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum 5 years of experience.
- C. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- D. Date stamp all castings used for coupling housings, fittings, valve bodies, etc. for quality assurance and traceability.
- E. Coupling Manufacturer:
  - 1. Perform on-site training by factory-trained representative to the Contractor's field personnel in the proper use of grooving tools and installation of grooved joint products.
  - 2. Periodic job site visits by factory-trained representative to ensure best practices in grooved joint installation.
  - 3. A distributor's representative is not considered qualified to perform the training.
- F. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
  - 1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary protective coating on cast iron and steel valves.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## 1.7 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

## PART 2 PRODUCTS

### 2.1 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
  - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
  - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
  - 3. Grooved mechanical joints may be used in accessible locations only.
    - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
    - b. Grooved mechanical connections and joints comply with AWWA C606.
      - 1) Copper:
        - (a) Fittings: ASME B16.22 wrought copper and ASTM B75/B75M, copper tube or ASTM B584, bronze castings. Manufactured to copper tube dimensions.
        - (b) Couplings: To fit copper-tube dimensions; rigid pattern with offsetting angle pattern bolt pads; gasketed fitting with center leg gasket with pipe stop to ensure proper groove engagement, alignment, an pipe insertion depth, rated for minimum 230 deg F for use with ferrous housing, and ASTM A449 steel bolts and nuts; 300 psig minimum CWP pressure rating.
      - 2) Steel:
        - (a) Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A53/A53M, Type F, E, or S, Grade B factory fabricated steel; with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

- (b) Couplings: Two ductile- or malleable-iron housings, rigid pattern unless otherwise indicated and EPDM gasket of central cavity pressure-responsive design; with ASTM A449 compliant nuts, bolts to secure grooved pipe and fittings. AGS two-segment couplings for pipe sizes 14" and larger, with wide-width gasket and lead-in chamfer on housing key.
- c. Use rigid joints with offsetting angle pattern bolt pads unless otherwise indicated.
- d. Depending on pipe size, three or four flexible joints may be used in lieu of a flexible connector.
- 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
  - 1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
  - 1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch ball valves with cap; pipe to nearest floor drain.
- E. Welding Materials and Procedures: Comply with ASME BPVC-IX.

## 2.2 HYDRONIC WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
  - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
  - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
  - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
  - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
    - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
    - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
  - 2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
  - 3. Mechanical Press Sealed Fittings: Pressed type complying with ASME B16.22.
    - a. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
    - b. Minimum 200-psig working-pressure rating at 250 deg F.
    - c. Manufacturers:
      - 1) NIBCO INC.
      - 2) Viega LLC.
      - 3) Apollo Valves; \_\_\_\_\_: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
- C. Pressure-Rated Polypropylene Pipe: ASTM D2774 or ASTM F2389, PP-RCT resin pipe with fiber layer, SDR 11 or SDR 9.
  - 1. Fittings: ASTM F2389, butt, socket, or saddle-weld heat fusion. Transitions to comply with ASTM F1960 or ASME B16.5.
  - 2. Manufacturers:
    - a. Aquatherm
    - b. IPEX USA LLC.
    - c. Nupi Americas



- d. Uponor, Inc.

## 2.3 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
- C. CPVC Pipe: ASTM F441/F441M, Schedule 40.
1. Fittings: ASTM F438 CPVC.
  2. Joints: Solvent welded in accordance with ASTM F493.

## 2.4 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  2. Hangers for Pipe Sizes 1/2 to 2-1/2 Inches: Carbon steel, adjustable swivel, split ring.
  3. Hangers for Cold Pipe Sizes 2-1/2 Inches and Greater: Carbon steel, adjustable, clevis.
  4. Hangers for Hot Pipe Sizes 2-1/2 to 6 Inches: Carbon steel, adjustable, clevis.
  5. Hangers for Hot Pipe Sizes 8 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
  6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
  8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  9. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.
  10. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
  11. Vertical Support: Steel riser clamp.
  12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  14. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
  15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  16. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  17. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.
- C. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
1. Bases: High-density polypropylene.
  2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
  3. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
5. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.
6. Manufacturers:
  - a. Miro Industries
  - b. nVent
  - c. PHP Systems/Design.

## **2.5 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS**

- A. Unions for Pipe of 2 Inches and Less:
  1. Ferrous Piping: 150 psi brass or malleable iron, threaded.
  2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
  1. Ferrous Piping: 150 psig forged steel, slip-on.
  2. Copper Piping: Bronze.
  3. Gaskets: 1/16 inch thick, preformed neoprene.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
  1. Dimensions and Testing: In accordance with AWWA C606.
  2. Mechanical Couplings: Comply with ASTM F1476.
  3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
  4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
  5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
  6. When pipe is field grooved, provide coupling manufacturer's grooving tools.
  7. Manufacturers:
    - a. Anvil International.
    - b. Grinnell Products.
    - c. Victaulic Company.
- D. Dielectric Connections:
  1. Waterways:
    - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    - b. Dry insulation barrier able to withstand 600-volt breakdown test.
    - c. Construct of galvanized steel with threaded end connections to match connecting piping.
    - d. Suitable for the required operating pressures and temperatures.
    - e. Manufacturers:
      - 1) Grinnell G-Fire by Johnson Controls Company.
      - 2) Precision Plumbing Products.
      - 3) Victaulic Company.
  2. Flanges:
    - a. Dielectric flanges with same pressure ratings as standard flanges.
    - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
    - c. Dry insulation barrier able to withstand 600-volt breakdown test.
    - d. Construct of galvanized steel with threaded end connections to match connecting piping.
    - e. Suitable for the required operating pressures and temperatures.
    - f. Manufacturers:
      - 1) Capitol Manufacturing Company.

- 2) Central Plastics Company.
  - 3) WATTS.
  - 4) Wilkins.
  - 5) Zurn Industries, LLC.
3. Unions:
- a. 1/2 to 1 Inches: Brass solder to galvanized FPT.
  - b. 1/2 to 2 Inches: Brass solder to galvanized FPT.
  - c. 1/2 to 1 Inches: Brass to galvanized FPT or FIP (Female Iron Pipe).
  - d. 3/4 to 1/2 Inch Reducer: Brass solder to galvanized FPT.
  - e. Service: 250 psi, minus 20 to 180 deg F.
  - f. Manufacturers:
    - 1) Capitol Manufacturing Company.
    - 2) Central Plastics Company.
    - 3) HART Industrial Unions, LLC.
    - 4) Jomar Valve.
    - 5) WATTS.
    - 6) Wilkins.
    - 7) Zurn Industries, LLC.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. CPVC Pipe: Make solvent-welded joints in accordance with ASTM F493.
- C. PP-RCT Pipe: Make heat fusion joint per manufacturers instructions.
- D. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- E. Install piping to conserve building space and to avoid interference with use of space.
- F. Group piping whenever practical at common elevations.
- G. Sleeve pipe passing through partitions, walls, and floors.
- H. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- I. Slope piping and arrange to drain at low points.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 05 16.
- K. Grooved Joints:
  1. Install in accordance with the manufacturer's latest published installation instructions.
  2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- L. Pipe Hangers and Supports:
  1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
  2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
  4. Place hangers within 12 inches of each horizontal elbow.
  5. Use hangers with 1-1/2 inches minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  8. Provide copper plated hangers and supports for copper piping.
  9. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 07 19.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. See Section 09 91 23.
- P. Install valves with stems upright or horizontal, not inverted.

### 3.3 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  4. 2-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  5. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  6. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
  7. 6 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
  8. 8 Inches: Maximum span, 16 feet; minimum rod size, 5/8 inch.
- B. Hanger Spacing for Steel Piping.
1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  5. 2-1/2 Inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  6. 3 Inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  7. 4 Inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
  8. 6 Inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
  9. 8 Inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
  10. 10 Inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
  11. 12 Inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
- C. Hanger Spacing for Plastic Piping.
1. 1/2 Inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
  2. 3/4 Inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
  3. 1 Inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
  4. 1-1/4 Inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
  5. 1-1/2 Inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
  6. 2 Inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.
  7. 3 Inches: Maximum span, 7 feet; minimum rod size, 3/8 inch.



8. 4 Inches: Maximum span, 8 feet; minimum rod size, 1/2 inch.
9. 6 Inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.
10. 8 Inches: Maximum span, 11 feet; minimum rod size, 5/8 inch.
11. 10 Inches: Maximum span, 13 feet; minimum rod size, 3/4 inch.
12. 12 Inches: Maximum span, 14 feet; minimum rod size, 7/8 inch.

**END OF SECTION**



## SECTION 23 21 14 - HYDRONIC SPECIALTIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Air vents.
- B. Strainers.
- C. Pressure-temperature test plugs.
- D. Balancing valves.
- E. Automatic flow control valves.
- F. Flow meters.
- G. Radiator valves.
- H. Relief valves.
- I. Pressure reducing valves.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.

#### 1.3 REFERENCE STANDARDS

- A. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Project Record Documents: Record actual locations of flow controls.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Glycol Solution: One container, 55 gallon size.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### PART 2 PRODUCTS

#### 2.1 AIR VENTS

- A. Manufacturers:
  - 1. Amtrol Inc.
  - 2. Apollo Valves.
  - 3. Armstrong International, Inc.

4. Bell & Gossett, a brand of Xylem, Inc.
  5. Nexus Valve, Inc.
  6. Nibco
  7. Taco, Inc.
  8. WATTS
- B. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- C. Float Air Vent:
1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
- D. Hygroscopic Air Vent:
1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring-loaded ball check valve.
- E. Maximum Fluid Pressure: 150 psi.
- F. Maximum Fluid Temperature: 250 degrees F.

## 2.2 STRAINERS

- A. Manufacturers:
1. Armstrong International, Inc.
  2. Grinnell Products.
  3. Keckley Company
  4. Nexus Valve, Inc.
  5. The Metraflex Company.
  6. Titan Flow Control, Inc.
  7. Victaulic Company.
  8. WATTS.
- B. Size 2 inch and Under:
1. Provide threaded, grooved, or sweat brass or iron body for up to 125 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated final screen. 60 mesh startup strainer. .
  2. Body Material by Fluid Service:
    - a. Cast Iron or Brass:
      - 1) Steam: Up to 250 psi at 450 degrees F.
      - 2) Liquids: Up to 400 psi at 150 degrees F.
- C. Size 2-1/2 inch to 4 inch:
1. Provide flanged or grooved iron body for up to 125 psi working pressure, up to 250 degrees F working temperature, Y-pattern strainer with 1/16 inch or 3/64 inch stainless steel perforated screen. 60 mesh startup strainer. .
  2. Body Material by Fluid Service:
    - a. Cast Iron:
      - 1) Steam: Up to 125 psi at 350 degrees F.
      - 2) Liquids: Up to 200 psi at 150 degrees F.
- D. Size 5 inch and Larger:
1. Provide flanged or grooved iron body for up to 175 psi working pressure, basket pattern with 1/8 inch stainless steel perforated screen.
- E. Basket-Type, Size 1 to 30 inch for Liquid Service:
1. Flanged carbon steel body with 1/8 inch stainless steel perforated basket screen, bottom drain and capped air vent. 60 mesh startup strainer .
  2. Fluid Service: Up to 285 psi at 100 degrees F.



- F. Accessories: Provide blowdown vent/drain and hanging tag.

### **2.3 PRESSURE-TEMPERATURE TEST PLUGS**

- A. Manufacturers:
1. Flow Design, Inc.
  2. Miljoco Corporation.
  3. Nexus Valve, Inc.
  4. Peterson Equipment Company Inc.
  5. Trerice, H. O. Co.
  6. Weiss Instruments, Inc.
- B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and EPDM rated for minimum 200 degrees F.
- C. Application: Use extended length plugs to clear insulated piping.

### **2.4 BALANCING VALVES**

- A. Manufacturers:
1. Armstrong International, Inc.
  2. Bell & Gossett, a brand of Xylem, Inc.
  3. Flow Design, Inc.
  4. Griswold Controls
  5. Nexus Valve, Inc.
  6. Nibco Inc.
  7. Pro Hydronics Specialties
  8. Taco, Inc.
  9. Tour & Andersson.
  10. Victaulic Company
  11. WATTS
- B. Size 2 inch and Smaller:
1. Provide ball, globe, or plug style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and female sweat, NPT threaded, or soldered connections.
  2. Metal construction materials consist of bronze or brass.
  3. Non-metal construction materials consist of EPDM or engineered resin.
  4. Maximum Service Operation: 255 psi at 240 degrees F.
- C. Size 2-1/2 inch and Larger:
1. Provide ball, globe, or plug style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and flanged or grooved connections.
  2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
  3. Internal components construction materials consist of brass, bronze, EPDM, or engineered resin.
  4. Maximum Service Operation: 175 psi at 250 degrees F.

### **2.5 AUTOMATIC FLOW CONTROL VALVES**

- A. Manufacturers:
1. Armstrong International.
  2. Bell & Gossett, a brand of Xylem, Inc.
  3. Flow Design, Inc.
  4. Flowcon Americas LLC.
  5. Griswold Controls
  6. Hays Fluid Controls.
  7. Nexus Valve, Inc.
  8. Nibco Inc.

9. Tour & Andersson
  10. Victaulic Company
  11. WATTS
- B. Construction:
1. Brass, bronze, or iron body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
  2. Built-in lug-type outlet butterfly valve with 2-position handle.
- C. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.
- D. Control Mechanism: Provide stainless steel or nickel-plated, brass piston or regulator cup, operating against stainless steel helical or wave formed spring or elastomeric diaphragm and polyphenylsulfone orifice plate.
- E. Size: As indicated on drawings.
- F. Accessories: Provide hanging tag, inlet in-line strainer, outlet ball valve, and PT test plug extension.

## **2.6 FLOW METERS**

- A. Manufacturers:
1. Dwyer Instruments, Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).
  2. EMCO Flow Systems: [www.emcoflow.com/#sle](http://www.emcoflow.com/#sle).
- B. Orifice principle by-pass circuit with direct reading gauge, soldered or flanged piping connections for 125 psi working pressure, with shut off valves, and drain and vent connections.
- C. Direct reading with insert pitot tube, threaded coupling, for 150 psi working pressure, maximum 240 degrees F, 5 percent accuracy.
- D. Calibrated, plug type balance valve with precision machined orifice, readout valves equipped with integral check valves and gasketed caps, calibrated nameplate, and indicating pointer.

## **2.7 RADIATOR VALVES**

- A. Manufacturers:
1. Armstrong International, Inc.
  2. Bell & Gossett, a brand of Xylem, Inc.
  3. Dwyer Instruments, Inc.
- B. Angle or straight pattern, rising stem, inside screw globe valve for 125 psi working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

## **2.8 RELIEF VALVES**

- A. Manufacturers:
1. Amtrol, Inc.
  2. Apollo Valves.
  3. Armstrong International, Inc.
  4. Bell & Gossett, a brand of Xylem, Inc.
  5. WATTS
- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

## **2.9 PRESSURE REDUCING VALVES**

- A. Manufacturers:
1. Amtrol, Inc.
  2. Apollo Valves.
  3. Armstrong International, Inc.

4. Bell & Gossett, a brand of Xylem, Inc.
  5. Victaulic Company.
  6. WATTS.
- B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve.
- C. Materials of Construction:
1. Valve Body: Constructed of bronze or brass.
  2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.
- D. Connections:
1. NPT threaded: 1/2 inch or 3/4inch.
  2. Soldered: 1/2 inch.
- E. Provide integral check valve and strainer.
- F. Maximum Inlet Pressure: 400 psi.
- G. Maximum Fluid Temperature: 180 degrees F.
- H. Adjustable Pressure Range: From 10 to 45 psi, set to 25 psi.

## 2.10 AUTOMATIC FLOW LIMITING VALVES

- A. Manufacturers:
1. Bell & Gossett; a Xylem brand.
  2. Flow Design, Inc.
  3. Flowcon Americas LLC.
  4. Griswold Controls LLC.
  5. Nexus Valve, Inc.
  6. NIBCO INC.
  7. Tour & Andersson; available through Victaulic Company.
  8. Victaulic Company.
  9. WATTS.
- B. Size 1/2 inch to 14 inch:
1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
  2. Metal construction materials consist of bronze, brass, or ductile iron.
  3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.
- C. Size 2-1/2 inch to 24 inch:
1. Comply with ASME B16.5.
  2. Class: 150.
  3. Provide ball, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged or grooved connections.
  4. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
  5. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, NORYL, or engineered resin.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Install shutoff valves at each branch connection to supply mains and at supply connection to each piece of equipment and where indicated on drawings.

- C. Install balancing valves at each branch connection to return main and where indicated on drawings.
- D. Install balancing valves in the return pipe of each heating or cooling terminal and where indicated on drawings.
- E. Install check valves at each pump discharge and elsewhere as required to control flow direction and where indicated on drawings.
- F. Provide manual air vents at system high points and as indicated.
- G. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- H. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- I. Provide valved drain and hose connection on strainer blowdown connection.
- J. Provide pump suction fitting on suction side of base-mounted centrifugal pumps. Remove temporary strainers after cleaning systems.
- K. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps.
- L. Support pump fittings with floor-mounted pipe and flange supports.
- M. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- N. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- O. Pipe relief valve outlet to nearest floor drain.
- P. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.
- Q. Clean and flush glycol system before adding glycol solution, see Section 23 25 00.
- R. Feed glycol solution to system through make-up line with pressure regulator, venting system high points. Set to fill at 12 psi.
- S. Perform tests determining strength of glycol and water solution and submit written test results.

### **3.2 MAINTENANCE**

- A. See Section 01 70 00 - Execution Requirements for additional requirements relating to maintenance service.
- B. Provide service and maintenance of glycol system for one year from date of Substantial Completion at no extra charge to Owner.
- C. Perform monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Report findings in detail in writing, including analysis and amounts of glycol or water added.
- D. Explain corrective actions to Owner's maintenance personnel in person.

**END OF SECTION**

## SECTION 23 23 00 - REFRIGERANT PIPING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure relief valves.
- H. Filter-driers.
- I. Solenoid valves.
- J. Expansion valves.
- K. Flexible connections.
- L. Exterior penetration accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 91 23 - Interior Painting.
- C. Section 23 07 16 - HVAC Equipment Insulation.
- D. Section 23 07 19 - HVAC Piping Insulation.
- E. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

#### 1.3 REFERENCE STANDARDS

- A. AHRI 710 (I-P) - Performance Rating of Liquid-Line Driers.
- B. AHRI 711 (SI) - Performance Rating of Liquid-Line Driers.
- C. AHRI 730 (I-P) - Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers.
- D. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants.
- E. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.
- F. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
- I. ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- J. ASME B31.9 - Building Services Piping.
- K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- L. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- N. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- O. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

- P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- Q. UL 429 - Electrically Operated Valves.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide general assembly of specialties, including manufacturer's catalogue information. Provide manufacturer's catalog data including load capacity.
- C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- D. Test Reports: Indicate results of leak test, acid test.
- E. Submit welders certification of compliance with ASME BPVC-IX.
- F. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Filter-Dryer Cartridges: One of each type and size.
  - 2. Refrigeration Oil Test Kits: One, each containing everything required to conduct one test.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

### **PART 2 PRODUCTS**

#### **2.1 SYSTEM DESCRIPTION**

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
  - 1. Use line size liquid indicators in main liquid line leaving condenser.
  - 2. If receiver is provided, install in liquid line leaving receiver.
  - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
  - 1. Use service valves on suction and discharge of compressors.
  - 2. Use gauge taps at compressor inlet and outlet.
  - 3. Use gauge taps at hot gas bypass regulators, inlet and outlet.
  - 4. Use check valves on compressor discharge.
  - 5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
  - 1. Use line size strainer upstream of each automatic valve.
  - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.

H. Filter-Driers:

1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
2. Use a filter-drier on suction line just ahead of compressor.
3. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.
4. Use sealed filter-driers in low temperature systems.
5. Use sealed filter-driers in systems utilizing hermetic compressors.
6. Use replaceable core filter-driers in lines of 1/2 inch outside diameter or greater.
7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
8. Use filter-driers for each solenoid valve.

I. Solenoid Valves:

1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
2. Use in liquid line of single or multiple evaporator systems.
3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

J. Receivers:

1. Use on systems \_\_\_\_\_ tons and larger, sized to accommodate pump down charge.
2. Use on systems with long piping runs.

K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

## 2.2 REGULATORY REQUIREMENTS

- A. Comply with ASME B31.9 for installation of piping system.
- B. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

## 2.3 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
  1. Fittings: ASME B16.22 wrought copper.
  2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8-inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
  1. Fittings: ASME B16.26 cast copper.
  2. Joints: Flared.
- C. Pipe Supports and Anchors:
  1. Provide hangers and supports that comply with MSS SP-58.
    - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel adjustable swivel, split ring.
  3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  6. Vertical Support: Steel riser clamp.
  7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  8. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  9. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
  10. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:

- a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
- b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
- c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
- d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
- e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

## 2.4 REFRIGERANT

- A. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

## 2.5 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers:
  1. Danfoss, Inc.
  2. Henry Technologies.
  3. Parker Hannifin - Sporlan Division.
- B. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

## 2.6 VALVES

- A. Manufacturers:
  1. Danfoss, Inc.
  2. Henry Technologies.
  3. Parker Hannifin - Sporlan Division.
- B. Diaphragm Packless Valves:
  1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Packed Angle Valves:
  1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, soldered or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- D. Ball Valves:
  1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
- E. Service Valves:
  1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi.

## 2.7 STRAINERS

- A. Manufacturers:
  1. Danfoss, Inc.
  2. Henry Technologies.
  3. Parker Hannifin - Sporlan Division.
- B. Straight Line or Angle Line Type:
  1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.



## 2.8 CHECK VALVES

- A. Manufacturers:
  - 1. Danfoss, Inc.
  - 2. Henry Technologies.
  - 3. Parker Hannifin.
- B. Globe Type:
  - 1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.
- C. Straight Through Type:
  - 1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

## 2.9 PRESSURE RELIEF VALVES

- A. Manufacturers:
  - 1. Danfoss, Inc.
  - 2. Henry Technologies.
  - 3. Parker Hannifin - Sporlan Division.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 400 psi.

## 2.10 FILTER-DRIERS

- A. Manufacturers:
  - 1. Danfoss, Inc.
  - 2. Flow Controls Division of Emerson Electric.
  - 3. Henry Technologies.
  - 4. Parker Hannifin - Sporlan Division.
- B. Performance:
  - 1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710 (I-P) (AHRI 711 (SI)).
  - 2. Flow Capacity - Suction Line: As indicated in schedule, minimum, rated in accordance with AHRI 730 (I-P).
  - 3. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
  - 4. Design Working Pressure: 500 psi, minimum.
- C. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- D. Construction: UL listed.
  - 1. Replaceable Core Type: Steel shell with removable cap.
  - 2. Sealed Type: Copper shell.
  - 3. Connections: As specified for applicable pipe type.

## 2.11 SOLENOID VALVES

- A. Manufacturers:
  - 1. Danfoss, Inc.
  - 2. Flow Controls Division of Emerson Electric.
  - 3. Henry Technologies.
  - 4. Parker Hannifin - Sporlan Division.

- B. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), with flared, soldered, or threaded ends; for maximum working pressure of 450 psi.
- C. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box.
- D. Electrical Characteristics: \_\_\_\_\_ watts, \_\_\_\_\_ volts, single phase, 60 Hz.

## 2.12 EXPANSION VALVES

- A. Manufacturers:
  - 1. Danfoss, Inc.
  - 2. Flow Controls Division of Emerson Electric.
  - 3. Henry Technologies.
  - 4. Parker Hannifin - Sporlan Division.
- B. Angle or Straight Through Type: AHRI 760 (I-P); design suitable for refrigerant, brass body, internal or external equalizer, mechanical pressure limit (maximum operating pressure MOP feature), adjustable superheat setting, replaceable inlet strainer, with nonreplaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

## 2.13 FLEXIBLE CONNECTORS

- A. Manufacturers:
  - 1. Circuit Hydraulics, Ltd.
  - 2. Flexicraft Industries.
  - 3. Penflex.
- B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

## 2.14 EXTERIOR PENETRATION ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
- B. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain-end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.2 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.

- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Install refrigerant piping in protective PVC conduit where installed below ground.
- G. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- H. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.5.
  - 2. Support horizontal piping as indicated.
  - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  - 4. Place hangers within 12 inches of each horizontal elbow.
  - 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 7. Provide copper plated hangers and supports for copper piping.
- I. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- J. Provide clearance for installation of insulation and access to valves and fittings.
- K. Provide access to concealed valves and fittings.
- L. Flood piping system with nitrogen when brazing.
- M. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- N. Prepare unfinished pipe, fittings, supports, and accessories for finish painting. See Section 09 91 23.
- O. Insulate piping and equipment.
- P. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- Q. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- R. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- S. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- T. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- U. Fully charge completed system with refrigerant after testing.
- V. Provide electrical connection to solenoid valves. See Section 26 05 83.

### **3.3 FIELD QUALITY CONTROL**

- A. Test refrigeration system in accordance with ASME B31.5.

- B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using electronic leak detector. Test and repair piping until no leakage.

### 3.4 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
  - 1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  - 2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  - 3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  - 4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  - 8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
  - 9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

**END OF SECTION**

## SECTION 23 31 00 - HVAC DUCTS AND CASINGS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- B. Section 23 33 00 - Air Duct Accessories.
- C. Section 23 36 00 - Air Terminal Units.
- D. Section 23 37 00 - Air Outlets and Inlets: Fabric air distribution devices.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
- H. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.
- I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for duct materials.
- C. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.
- D. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meets or exceed specified requirements.
- E. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).
- F. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- G. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

#### 1.6 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

## 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated. Fibrous glass duct can be substituted at the Contractor's option.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23 33 19.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
  - 1. Round: Plus or minus 2 in-wc of galvanized steel.
  - 2. Rectangular: Plus or minus 1/2 in-wc of galvanized steel.
  - 3. Fibrous Glass Duct-board: Plus or minus 1/2 in-wc.
  - 4. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
  - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
    - a. Supply Air: 1/2 in-wc pressure class, galvanized steel.
    - b. Outside Air Intake: 1/2 in-wc pressure class, galvanized steel.
    - c. Return and Relief Air: 1/2 in-wc pressure class, galvanized steel.
    - d. General Exhaust Air: 1/2 in-wc pressure class, galvanized steel.
  - 2. Low Pressure Service: Up to 2 in-wc:
    - a. Seal: Class C, apply to seal off transverse joints.
    - b. Leakage:
      - 1) Rectangular: Class 24 or 24 cfm/100 sq ft.
      - 2) Round: Class 12 or 12 cfm/100 sq ft.
  - 3. Low Pressure Service: From 2 in-wc to 3 in-wc:
    - a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
    - b. Leakage:
      - 1) Rectangular: Class 12 or 12 cfm/100 sq ft.
      - 2) Round: Class 6 or 6 cfm/100 sq ft.
  - 4. Medium and High Pressure Service: Above 3 in-wc:
    - a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
    - b. Leakage:
      - 1) Rectangular: Class 6 or 6 cfm/100 sq ft.
      - 2) Round: Class 3 or 3 cfm/100 sq ft.
- F. Duct Fabrication Requirements:
  - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
  - 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
  - 3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
  - 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

## 2.2 METAL DUCTS

- A. Material Requirements:
  1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Fire Rated Ducts:
  1. Two-hour, Fire Rated Duct:
    - a. UL labeled, construct of 18-gauge, 0.0516-inch galvanized steel.
    - b. R-Value: 4.5 when tested in accordance with ASTM C177.
- C. Round Metal Ducts:
  1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
  2. Round Double Wall Insulated Duct: Round spiral lock seam duct with galvanized steel outer wall, perforated galvanized steel inner wall; fitting with the solid inner wall.
    - a. Insulation:
      - 1) Thickness: 1 inch.
      - 2) Material: Air.
    - b. Manufacturers:
      - 1) Substitutions: See Section 01 60 00 - Product Requirements.
  3. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
- D. Round Spiral Duct:
  1. Round spiral lock seam duct with galvanized steel outer wall.
- E. Connectors, Fittings, Sealants, and Miscellaneous:
  1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
  2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
  3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
    - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
    - b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
    - c. For Use with Flexible Ducts: UL labeled.
  4. Gasket Tape:
    - a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
  5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
  6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:

## 2.3 FLEXIBLE DUCTS

- A. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form spiral helix.

1. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
  2. Maximum Velocity: 5500 fpm.
  3. Temperature Range: Minus 20 degrees F to 250 degrees F.
- B. Flexible Air Ducts:
1. UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound spring steel wire.
  2. Pressure Rating: From 10 in-wc positive to 1 in-wc negative.
  3. Maximum Velocity: 4,000 fpm.
  4. Temperature Range: Minus 20 to 210 degrees F.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Flexible Ducts: Connect to metal ducts with adhesive.
- G. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- H. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with a crimp in the direction of airflow.
- K. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated in Sections 23 33 00, 23 36 00, and 23 37 00.
- L. Duct Insulation: Provide duct insulation. See Section 23 07 13.

**END OF SECTION**



## SECTION 23 33 00 - AIR DUCT ACCESSORIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Backdraft dampers - metal.
- B. Backdraft dampers - fabric.
- C. Fiberglass backdraft dampers.
- D. Combination fire and smoke dampers.
- E. Duct access doors.
- F. Duct test holes.
- G. Fire dampers.
- H. Flexible duct connectors.
- I. Smoke dampers.
- J. Volume control dampers.
- K. Miscellaneous Products:
  - 1. Damper operators.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings.

#### 1.3 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.
- B. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks.
- C. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- E. NFPA 92 - Standard for Smoke Control Systems.
- F. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.
- H. UL 33 - Safety Heat Responsive Links for Fire-Protection Service.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- K. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- L. UL 263 - Standard for Fire Tests of Building Construction and Materials.
- M. UL 555 - Standard for Fire Dampers.
- N. UL 555C - Standard for Safety Ceiling Dampers.
- O. UL 555S - Standard for Smoke Dampers.
- P. UL 1978 - Grease Ducts.
- Q. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

## PART 2 PRODUCTS

### 2.1 BACKDRAFT DAMPERS - METAL

- A. Manufacturers:
- B. Gravity Backdraft Dampers, Size 18 by 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

### 2.2 BACKDRAFT DAMPERS - FABRIC

- A. Fabric Backdraft Dampers: Factory-fabricated.
  1. Blades: Neoprene coated fabric material.
  2. Birdscreen: 1/2 inch nominal mesh of galvanized steel or aluminum.
  3. Maximum Velocity: 1000 fpm (5 mps) face velocity.

### 2.3 FIBERGLASS BACKDRAFT DAMPERS

- A. Manufacturers:
  1. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
  2. Substitutions: See Section 01 60 00 - Product Requirements.

### 2.4 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
  1. AireTechnologies, Inc, a DMI Company: [www.airetechnologies.com/#sle](http://www.airetechnologies.com/#sle).
  2. Lloyd Industries, Inc: [www.firedamper.com/#sle](http://www.firedamper.com/#sle).
  3. Louvers & Dampers, Inc, a brand of Mestek, Inc: [www.louvers-dampers.com/#sle](http://www.louvers-dampers.com/#sle).
  4. Nailor Industries, Inc: [www.nailor.com/#sle](http://www.nailor.com/#sle).
  5. NCA, a brand of Metal Industries Inc: [www.ncamfg.com/#sle](http://www.ncamfg.com/#sle).
  6. Pottorff: [www.pottorff.com/#sle](http://www.pottorff.com/#sle).
  7. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
  8. United Enertech: [www.unitedenertech.com/#sle](http://www.unitedenertech.com/#sle).

### 2.5 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick-fastening locking devices. For insulated ducts, install minimum 1-inch thick insulation with sheet metal cover.

### 2.6 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

### 2.7 FIRE DAMPERS

- A. Manufacturers:
  1. AireTechnologies, Inc, a DMI Company: [www.airetechnologies.com/#sle](http://www.airetechnologies.com/#sle).
  2. Lloyd Industries, Inc: [www.firedamper.com/#sle](http://www.firedamper.com/#sle).
  3. Louvers & Dampers, Inc, a brand of Mestek, Inc: [www.louvers-dampers.com/#sle](http://www.louvers-dampers.com/#sle).
  4. Nailor Industries, Inc: [www.nailor.com/#sle](http://www.nailor.com/#sle).
  5. NCA, a brand of Metal Industries Inc: [www.ncamfg.com/#sle](http://www.ncamfg.com/#sle).
  6. Panasonic Corporation of North America; Flex Damper: [www.panasonic.com/#sle](http://www.panasonic.com/#sle).

7. Pottorff: [www.pottorff.com/#sle](http://www.pottorff.com/#sle).
  8. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
  9. United Enertech: [www.unitedenertech.com/#sle](http://www.unitedenertech.com/#sle).
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.
- D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch pressure-class ducts up to 12 inches in height.
- E. Multiple Blade Dampers: 16-gauge, 0.0598-inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- F. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.
- G. Security Bars: Comply with NFPA 90A, UL 555, and UL 555S. Install per manufacturer's instructions.

## 2.8 FLEXIBLE DUCT CONNECTORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
- C. Maximum Installed Length: 14 inch.

## 2.9 SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- B. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by pneumatic actuator.
- C. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

## 2.10 VOLUME CONTROL DAMPERS

- A. Manufacturers:
1. AireTechnologies, Inc, a DMI Company: [www.airetechnologies.com/#sle](http://www.airetechnologies.com/#sle).
  2. Louvers & Dampers, Inc, a brand of Mestek, Inc: [www.louvers-dampers.com/#sle](http://www.louvers-dampers.com/#sle).
  3. Elgen Manufacturing Company, Inc: [www.elgenmfg.com/#sle](http://www.elgenmfg.com/#sle).
  4. MKT Metal Manufacturing: [www.mktduct.com/#sle](http://www.mktduct.com/#sle).
  5. Nailor Industries, Inc: [www.nailor.com/#sle](http://www.nailor.com/#sle).
  6. NCA, a brand of Metal Industries Inc: [www.ncamfg.com/#sle](http://www.ncamfg.com/#sle).
  7. Pottorff: [www.pottorff.com/#sle](http://www.pottorff.com/#sle).
  8. Ruskin Company: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
  9. United Enertech: [www.unitedenertech.com/#sle](http://www.unitedenertech.com/#sle).
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Splitter Dampers:
1. Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
  2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- D. Single Blade Dampers:
1. Fabricate for duct sizes up to 6 by 30 inch.

2. Blade: 24 gauge, 0.0239 inch, minimum.
3. Manufacturers:

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. Use splitter dampers only where indicated if applicable.
- J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

**END OF SECTION**

## SECTION 23 34 23 - HVAC POWER VENTILATORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Downblast roof exhausters.
- B. Wall exhausters.
- C. Upblast roof exhausters.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- C. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- E. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.
- F. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

#### 1.3 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program.
- B. AMCA 99 - Standards Handbook.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fan roof curbs and service utilities installation according to fan size.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Fan Belts: One set for each individual fan.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

### PART 2 PRODUCTS

#### 2.1 POWER VENTILATORS - GENERAL

- A. Manufacturers:
  - 1. Acme Manufacturing Corp.
  - 2. Aerovent, a division of Twin City Fan.

3. Greenheck Fan Corporation.
  4. Loren Cook Company.
  5. PennBarry, Division of Air System Components.
- B. Static and Dynamically Balanced: Comply with AMCA 204.
- C. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- D. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- E. Fabrication: Comply with AMCA 99.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Motors: refer to requirements in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

## 2.2 DOWNBLAST ROOF EXHAUSTERS

- A. Manufacturers:
1. Carnes, a division of Carnes Company Inc.
  2. Greenheck Fan Corporation; \_\_\_\_\_.
  3. Patterson Fan Company.
  4. PennBarry, Division of Air System Components.
  5. Quietaire Corporation.
  6. Twin City Fan & Blower.
- B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: 8 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- D. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
- E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- G. Performance Ratings: As indicated on drawings.

## 2.3 WALL EXHAUSTERS

- A. Manufacturers:
1. Carnes, a division of Carnes Company Inc: [www.carnes.com/#sle](http://www.carnes.com/#sle).
  2. Greenheck Fan Corporation: [www.greenheck.com/#sle](http://www.greenheck.com/#sle).
  3. Patterson Fan Company, Inc: [www.pattersonfan.com/#sle](http://www.pattersonfan.com/#sle).
  4. PennBarry, Division of Air System Components: [www.pennbarry.com/#sle](http://www.pennbarry.com/#sle).
  5. Twin City Fan & Blower; WPB: [www.tcf.com/#sle](http://www.tcf.com/#sle).
- B. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch mesh, 0.062 inch thick aluminum wire bird screen.
- C. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor, and wall mounted multiple speed switch.

- D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- E. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm can be reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Provide and install duct adaptors as necessary. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
  - 1. Install fans with resilient mountings and flexible electrical leads, see Section 23 05 48 - Vibration and Seismic Controls for HVAC.
  - 2. Install flexible connections between fan and ductwork; see Section 23 33 00 - Air Duct Accessories. Ensure metal bands of connectors are parallel with minimum 1 inch flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.
- H. Electrical Connections: Connect wiring according to Section 26 05 83 - Wiring Connections.
- I. Controls Connections: Install per manufacturer's recommendations.
- J. Test and adjust equipment in accordance with manufacturer's recommendations.
- K. Perform Test and Balance according to Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- L. Labels units in accordance with requirements shown in Section 23 05 53 - Identification for HVAC Piping and Equipment .

**END OF SECTION**





## SECTION 23 37 00 - AIR OUTLETS AND INLETS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Diffusers:
  - 1. Perforated ceiling diffusers.
- B. Rectangular ceiling diffusers.
- C. Slot ceiling diffusers.
- D. Registers/grilles:
  - 1. Ceiling-mounted, egg crate exhaust and return register/grilles.
  - 2. Ceiling-mounted, exhaust and return register/grilles.
  - 3. Ceiling-mounted, linear exhaust and return register/grilles.
  - 4. Ceiling-mounted, supply register/grilles.
  - 5. Wall-mounted, supply register/grilles.
  - 6. Wall-mounted, exhaust and return register/grilles.
- E. Duct-mounted supply and return registers/louvers.
- F. Wall and ceiling gypsum board access panels with return air grilles.
- G. Louvers.
- H. Goosenecks.
- I. Gravity ventilators.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Painting of ducts visible behind outlets and inlets.

#### 1.3 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.
- C. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers.
- D. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

#### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

#### 1.5 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

## **PART 2 PRODUCTS**

### **2.1 RECTANGULAR CEILING DIFFUSERS**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Metalaire, a brand of Metal Industries Inc: [www.metalaire.com/#sle](http://www.metalaire.com/#sle).
  - 4. Nailor Industries
  - 5. Price Industries
  - 6. Shoemaker Manufacturing
  - 7. Titus, a brand of Air Distribution Technologies
  - 8. Tuttle and Bailey
- B. Type: Provide rectangular and square formed adjustable, backpan stamped, core removable, and multi-louvered ceiling diffusers constructed to maintain four way discharge air pattern with sectorizing baffles where indicated.
- C. Connections: As indicated on drawings.
- D. Frame: Provide inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- E. Fabrication: Material as indicated on drawings with baked acrylic finish.
- F. Color: As indicated on drawings.

### **2.2 PERFORATED FACE CEILING DIFFUSERS**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Metalaire, a brand of Metal Industries Inc: [www.metalaire.com/#sle](http://www.metalaire.com/#sle).
  - 4. Nailor Industries
  - 5. Price Industries
  - 6. Shoemaker Manufacturing
  - 7. Titus, a brand of Air Distribution Technologies
  - 8. Tuttle and Bailey
- B. Type: Perforated face with fully adjustable pattern and removable face.
- C. Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame.
- D. Fabrication: Steel face with steel back pan and baked acrylic finish.
- E. Color: As indicated on drawings.

### **2.3 CEILING SLOT DIFFUSERS**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Nailor Industries
  - 4. Price Industries
  - 5. Shoemaker Manufacturing
  - 6. Titus, a brand of Air Distribution Technologies
  - 7. Tuttle and Bailey
- B. Type: Refer to drawings for slot width and quantity, with adjustable black ice tong pattern controller for left, right, or vertical discharge.
- C. Fabrication: Aluminum extrusions with factory clear lacquer finish; center tees for diffusers with two or more slots.
- D. Color: As indicated on the drawings.

- E. Frame: 1-1/4 inch margin with support clips for T bar mounting and gasket, end cap. In plaster ceilings, provide plaster frame and ceiling frame.
- F. Plenum: Integral, galvanized steel, insulated.
- G. Accessories: As indicated on drawings.

## **2.4 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Nailor Industries
  - 4. Price Industries
  - 5. Shoemaker Manufacturing
  - 6. Titus, a brand of Air Distribution Technologies
  - 7. Tuttle and Bailey
- B. Type: Duct-mounted, rectangular register for round-spiral duct with double-deflection grille with adjustable pivot-ended blades, end caps, and dual cover flanges with gaskets to seal flush to duct surface regardless of diameter. Performance to match manufacturer's catalog data.
- C. Fabrication: Material as indicated on drawings with baked acrylic finish.
- D. Color: As indicated on drawings.
- E. Accessories: As indicated on drawings.

## **2.5 CEILING SUPPLY REGISTERS/GRILLES**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Nailor Industries
  - 4. Price Industries
  - 5. Shoemaker Manufacturing
  - 6. Titus, a brand of Air Distribution Technologies
  - 7. Tuttle and Bailey
- B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection. 3/4 inch minimum blade depth and 3/4 inch maximum spacing. Orient blades parallel to long dimension unless indicated otherwise.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- D. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked acrylic finish. Material as indicated on drawings.
- E. Color: As indicated on drawings.

## **2.6 CEILING EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Nailor Industries
  - 4. Price Industries
  - 5. Shoemaker Manufacturing
  - 6. Titus, a brand of Air Distribution Technologies
  - 7. Tuttle and Bailey

- B. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, horizontal face. Orient blades parallel to long dimension unless indicated otherwise.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting.
- D. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked acrylic finish. Material as indicated on drawings.
- E. Color: As indicated on drawings.
- F. Kitchens: Where return or exhaust grilles are located in kitchen areas provide filter frame and filter. Filter may be disposable or cleanable as indicated on the drawings.

## **2.7 CEILING LINEAR SUPPLY, EXHAUST AND RETURN GRILLES**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Metalaire, a brand of Metal Industries Inc: [www.metalaire.com/#sle](http://www.metalaire.com/#sle).
  - 4. Nailor Industries
  - 5. Price Industries
  - 6. Shoemaker Manufacturing
  - 7. Titus, a brand of Air Distribution Technologies
  - 8. Tuttle and Bailey
- B. Type: Blade angle, spacing and deflection as indicated on the drawings.
- C. Type: Streamlined blades with 0 degree deflection, 1/8 by 3/4 inch on 1/4 inch centers.
- D. Frame: 1-1/4 inch border, extra heavy for floor mounting, mounting as indicated on the drawings. For diffuser lengths requiring multiple sections provide alignment strips or pins to form continuous appearance with end-to-end joining.
- E. End Conditions: Both ends mitred.
- F. Fabrication: Aluminum extrusions, with factory anodized baked acrylic finish.
- G. Color: As indicated on the drawings.

## **2.8 CEILING EGG CRATE EXHAUST AND RETURN GRILLES**

- A. Manufacturers:
  - 1. Anemostat
  - 2. Krueger-HVAC
  - 3. Nailor Industries
  - 4. Price Industries
  - 5. Shoemaker Manufacturing
  - 6. Titus, a brand of Air Distribution Technologies
  - 7. Tuttle and Bailey
- B. Type: Sight-proof Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch grid core.
- C. Fabrication: Grid core consists of aluminum with baked acrylic finish. Border consist of aluminum with baked acrylic finish.
- D. Color: As indicated on the drawings.
- E. Frame: As indicated on the drawings.
- F. Kitchens: Where return or exhaust grilles are located in kitchen areas provide filter frame and filter. Filter may be disposable or cleanable as indicated on the drawings.

## **2.9 WALL SUPPLY REGISTERS/GRILLES**

- A. Manufacturers:

1. Anemostat
  2. Krueger-HVAC
  3. Nailor Industries
  4. Price Industries
  5. Shoemaker Manufacturing
  6. Titus, a brand of Air Distribution Technologies
  7. Tuttle and Bailey
- B. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, horizontal face, double deflection. Orient blades parallel to long dimension unless indicated otherwise.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- D. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked acrylic finish. Material as indicated on drawings.
- E. Color: As indicated on the drawings.

## **2.10 WALL EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Manufacturers:
1. Anemostat
  2. Krueger-HVAC
  3. Nailor Industries
  4. Price Industries
  5. Shoemaker Manufacturing
  6. Titus, a brand of Air Distribution Technologies
  7. Tuttle and Bailey
- B. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, horizontal face. Orient blades parallel to long dimension unless indicated otherwise.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting.
- D. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked acrylic finish. Material as indicated on drawings.
- E. Color: As indicated on the drawings.
- F. Kitchens: Where return or exhaust grilles are located in kitchen areas provide filter frame and filter. Filter may be disposable or cleanable as indicated on the drawings.

## **2.11 LOUVERS (EXTERIOR)**

- A. Manufacturers:
1. The Airolite Company.
  2. American Warming and Ventilating.
  3. Construction Specialties, Inc.
  4. Dowco.
  5. Greenheck
  6. Louvers & Dampers, Inc.
  7. Reliable.
  8. Ruskin Company
  9. United Enertech
- B. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
- C. Type: 6 inch deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh birdscreen over intake or exhaust end.

- D. Fabrication: 12 gauge, 0.1046 inch (2.66 mm) thick extruded aluminum welded assembly, intermediate mullions matching frames, with factory fluoropolymer spray finish as indicated on the drawings.
- E. Blades: Unless indicated otherwise, louvers shall have drainable blades, consisting of a continuous rain stop at front or rear of blade aligned with vertical gutter recessed in both jambs of frame.
- F. Pressure Drop: Air pressure drop for both exhaust and intake shall not exceed 0.15 inches w.g. with free area air velocities of 1000 feet per minute.
- G. Wind Load Resistance: Louvers shall resist positive and negative wind load of 25 psf without damage or permanent deformation.
- H. Water Penetration: Louvers shall allow a maximum of 0.01 oz/sq ft water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
- I. Minimum Free Area: As indicated on the drawings.
- J. Color: As indicated on the drawings.
- K. Accessories: As indicated on the drawings.
- L. Mounting: As indicated on the drawings.

## 2.12 LOUVERS (INTERIOR)

- A. Manufacturers:
  - 1. The Airolite Company.
  - 2. American Warming and Ventilating.
  - 3. Construction Specialties, Inc.
  - 4. Dowco.
  - 5. Greenheck
  - 6. Louvers & Dampers, Inc.
  - 7. Reliable.
  - 8. Ruskin Company
  - 9. United Enertech
- B. Type: 4 inch deep frame with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.
- C. Fabrication: 16 gauge, 0.0598 inch (1.52 mm) thick galvanized steel welded assembly, intermediate mullions matching frames, with factory fluoropolymer spray finish as indicated on the drawings.
- D. Pressure Drop: Air pressure drop for both exhaust and intake shall not exceed 0.15 inches w.g. with free area air velocities of 1000 feet per minute.
- E. Minimum Free Area: As indicated on the drawings.
- F. Color: As indicated on the drawings.
- G. Accessories: As indicated on the drawings.
- H. Mounting: As indicated on the drawings.

## 2.13 GOOSENECKS

- A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.
- B. Mount on minimum 16 inch high curb base.

## 2.14 GRAVITY VENTILATORS

- A. Hood Intake and Relief Gravity Ventilator:
  - 1. Manufacturers:
    - a. Carnes

- b. Greenheck Fan Corporation.
- c. Loren Cook Company.
- d. PennBarry
2. General:
  - a. Low silhouette for intake and relief applications with natural gravity or negative pressure system(s).
  - b. Performance ratings and factory testing in accordance with AMCA 511 and AMCA 550.
  - c. Suitable for ducted or non-ducted applications.
  - d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood and Base:
  - a. Material: Aluminum, minimum 16 gauge base and 18 gauge hood.
  - b. Hood Construction: Precision formed, arched panels with interlocking seams.
  - c. Vertical End Panels: Fully locked into hood end panels.
  - d. Curb Cap: Pre-punched mounting holes for installation.
4. Birdscreen:
  - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
  - b. Construction: 1/2 inch Galvanized mesh.
  - c. Horizontally mounted across hood intake area.
5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from base or hinged open.
6. Options/Accessories:
  - a. Roof Curbs:
    - 1) Flat Roofs:
      - (a) Welded, straight side curb with flashing flange and wood nailer.
    - 2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
    - 3) Material: Galvanized.
    - 4) Insulation Thickness: 1-1/2 inches.
  - b. Provide extended base minimum 5 inch extension to base height making overall base 12 inches in height to prevent snow or moisture intake.
  - c. Curb Seal: Rubber seal between fan and roof curb.
  - d. Dampers:
    - 1) Type: Motorized.
    - 2) Factory designed to prevent outside air from entering back into building when fan is off.
    - 3) Galvanized frames with pre-punched mounting holes.
  - e. Factory Finish: Thermo-setting polyester urethane.
  - f. Hood Insulation or Coating: Provide 1-inch fiberglass insulation lining or anti-condensate coating to prevent condensation and reduce sound levels.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.



- D. Install diffusers to ductwork with air tight connection.
- E. Provide factory installed balancing damper with register, grille or diffuser where ductwork installation does not accommodate the installation of duct-mounted balancing dampers on duct take-off.
- F. Paint ductwork visible behind air outlets and inlets matte black, see Section 09 91 23.
- G. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork. Install roof mounting curb level.

### **3.3 CLOSEOUT ACTIVITIES**

- A. Demonstrate operational system to Owner's representative.
- B. Instruct Owner's representative to maintain system and use occupant controls or interfaces, as required.

### **3.4 PROTECTION**

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

**END OF SECTION**



## **SECTION 23 81 26.13 - SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Air-source heat pumps.
- B. Air cooled condensing units.
- C. Indoor air handling (fan and coil) units for ductless systems.
- D. Controls.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete: Mounting pad for outdoor unit.
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- D. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- E. Section 23 21 13 - Hydronic Piping: Equipment drains and overflows.
- F. Section 23 23 00 - Refrigerant Piping.
- G. Section 23 40 00 - HVAC Air Cleaning Devices.

#### **1.3 REFERENCE STANDARDS**

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems.
- D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units.
- E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- F. NEMA MG 1 - Motors and Generators.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
- I. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Filters: One for each unit.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

## 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturers warranty for compressors from date of Substantial Completion.
- C. Provide one year manufacturers warranty for parts from date of Substantial Completion.
- D. Provide one year manufacturers warranty for labor from date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Daikin
- B. Fujitsu
- C. LG
- D. Trane Technologies, PLC / Mitsubishi

### 2.2 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
  - 1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator.
  - 2. Cooling: Outdoor electric condensing unit with evaporator coils in one or more ductless indoor units ("mini-split").
  - 3. Provide field-installed refrigerant piping between indoor and outdoor units; see 23 23 00.
- B. Performance Requirements: See Drawings for additional requirements.
  - 1. Efficiency:
    - a. Comply with ASHRAE Std 90.1.

### 2.3 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS

- A. Manufacturers:
  - 1. Daikin
  - 2. Fujitsu
  - 3. LG
  - 4. Trane Technologies, PLC / Mitsubishi
- B. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
  - 1. Air Flow Configuration: Horizontal.
  - 2. Cabinet: Galvanized steel, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
- C. Supply Fan: Forward-curved type with direct drive.
  - 1. Motor: NEMA MG 1; multiple speed, permanently lubricated. See 23 05 13.
- D. Air Filters: 1 inch thick urethane, washable type arranged for easy removal or replacement. See 23 40 00.
- E. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
  - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
  - 2. Manufacturers: System manufacturer.

## 2.4 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

- A. Manufacturers:
  - 1. Daikin
  - 2. Fujitsu
  - 3. LG
- B. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
  - 1. Location: wall-mount.
  - 2. Cabinet: Galvanized steel Enameled steel, easily removed access panels on front and ends.
    - a. Finish: White.
  - 3. Fan: Centrifugal type with direct drive.
    - a. Motor: NEMA MG 1; multiple speed, permanently lubricated. See 23 05 13.
  - 4. Filter return air with washable, antioxidant pre-filter and a pleated anti-allergy enzyme filter. See 23 40 00.
- C. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
  - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
  - 2. Manufacturer: System manufacturer.

## 2.5 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
  - 1. Comply with AHRI 210/240.
  - 2. Refrigerant: R-32 or R-454B.
  - 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
  - 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.
- B. Compressor: Hermetically sealed scroll, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high-pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
  - 1. Compressor Motor: Inverter-driven.
- C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
  - 1. Condenser Fans: Direct-drive propeller type.
  - 2. Condenser Fan Motor: Enclosed, permanently lubricated, with thermal-overload protection.
- D. Coil: Air-cooled, aluminum fins bonded to copper tubes.
- E. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
  - 1. Provide thermostatic expansion valves AND L.
  - 2. Provide heat pump reversing valves and low air temperature cutoff.
- F. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

- G. Mounting: Provide equipment support rails or manufacturer's equipment stand mounted on cast-in-place concrete equipment pad. Equipment stand to be minimum 18 inch height unless noted otherwise on drawings.

## 2.6 EQUIPMENT RAILS

- A. Manufacturers:
  - 1. Roof Products and Systems.
  - 2. The Pate Company.
- B. Basis of Design: Roof Products and Systems RPS Model ER-2B.
- C. Equipment Rail Curbs: Straight curbs on each side of equipment, with top of curbs horizontal and level with each other for equipment mounting.
- D. Construction: 18 gauge galvanized steel, continuously welded corner seems, integral base plate. Provide galvanized cap flashing with preservative treated wood nailers along top of rails with 1 inch overhang on all sides to allow for insulation.
- E. Rail Width: 5-1/2 inches, minimum, or width of supported equipment and accessories, whichever is greater.
- F. Rail Length: Contractor to verify length as required by supported equipment to adequately span structural members unless length is noted on drawings.
- G. Height Above Finished Roof Surface: 8 inches, minimum.
- H. Height Above Roof Deck: 16 inches, minimum.

## 2.7 ACCESSORY EQUIPMENT

- A. Line Set Covers:
  - 1. Material: Paintable high-quality PVC with UV inhibitors.
  - 2. Cover: Snap-on or Fastened with stainless steel fasteners.
  - 3. Fire rating: ULV94v-0 or UL94HB.
  - 4. Weather resistance: 2,000-hour test to JIS DO 205.
- B. Condensate Pumps
  - 1. Manufacturers:
    - a. Beckett Corporation.
    - b. Grundfos Pumps Corporation.
    - c. Little Giant; a Franklin Electric brand.
  - 2. Packaged Unit includes:
    - a. Minimum 1/2 gallon aluminum collection tank.
    - b. Centrifugal pump design.
    - c. Stainless steel motor shaft.
    - d. Automatic start and stop operation.
    - e. Float activated switch for automatic high-level water detection (overflow detection switch).
    - f. Thermally protected, fan cooled motor.
    - g. Maximum water temperature: 140 °F.
    - h. 6 ft, 3-conductor cable with grounded 3-prong plug.
- C. Controls
  - 1. Room Thermostat: Wall-mounted, wireless, electric solid state microcomputer based room thermostat to maintain temperature setting; low-voltage; with the following features:
    - a. System selector switch (heat-off-cool) and fan control switch (auto-on).
    - b. Automatic switching from heating to cooling.
    - c. Preferential rate control to minimize overshoot and deviation from setpoint.
    - d. Battery replacement without program loss.
    - e. Thermostat Display:
      - 1) Actual room temperature.

- 2) Programmed temperature.
- 3) System Mode Indication (adjustable): Heating, Cooling, Fan (Auto, Off, and On).

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

#### **3.2 PREPARATION**

- A. Install concrete equipment pads for outdoor units under provisions of Section 03 30 00. Size pads to extend a minimum 4 inches past all sides of equipment footprint.
- B. Install equipment rails sized and spaced to support outdoor units; extend rail length to provide mounting location for outdoor unit disconnect (coordinate with electrical contractor).

#### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install refrigeration systems in accordance with ASHRAE Std 15.
- D. Install units level and plumb.
- E. Pipe drain from cooling coils to nearest floor drain.
- F. Secure outdoor equipment to manufacturer's equipment stand or equipment support rails with corrosion-resistant fasteners; comply with vibration isolation requirements in 23 05 48. Where equipment stands are used, secure equipment stand to concrete or polyethylene pad with corrosion-resistant fasteners. Refer to drawings for specific mounting requirements.

#### **3.4 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform startup service; test, inspect, instruct, and observe field-assembled components and equipment installation, including connections. Report results in writing.
  1. Leak Test:
    - a. After installation, charge system and test for leaks.
    - b. Repair leaks and retest until no leaks exist.
  2. Operational Test:
    - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    - b. Test and adjust controls and safeties.
    - c. Replace damaged and malfunctioning controls and other equipment.
    - d. Remove and replace malfunctioning units and retest as specified above.

#### **3.5 CLEANING**

- A. After construction and painting is completed, clean exposed surfaces of units.
- B. Vacuum clean coils and inside of units.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- D. Install new filters.

#### **3.6 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals for closeout submittals.



B. See Section 01 79 00 - Demonstration and Training for additional requirements.

**3.7 PROTECTION**

A. Provide finished cabinet units with protective covers during the balance of construction.

**END OF SECTION**

## SECTION 23 82 00 - TERMINAL HEATING AND COOLING UNITS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Hydronic unit heaters.
- B. Hydronic cabinet unit heaters.
- C. Blower-coil units.
- D. Coil piping packages.

#### 1.2 RELATED REQUIREMENTS

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
- C. Section 23 07 19 - HVAC Piping Insulation.
- D. Section 23 21 13 - Hydronic Piping.
- E. Section 23 21 14 - Hydronic Specialties.
- F. Section 23 23 00 - Refrigerant Piping.
- G. Section 23 31 00 - HVAC Ducts and Casings.
- H. Section 23 40 00 - HVAC Air Cleaning Devices.

#### 1.3 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
  - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
  - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
  - 3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
  - 4. Submit the following for fan coil units, unit ventilators, vertical unit ventilators, and blower coil units indicating:
    - a. Overall dimensions including installation, operation, and service clearances.
    - b. Lift points, recommendations, and center of gravity.
    - c. Unit shipping, installation, and operating weights including dimensions.
    - d. Fan curves with specified operating point clearly plotted.
    - e. Safety and start-up instructions.
  - 5. Indicate mechanical and electrical service locations and requirements.
- D. Selection Samples: For each finish product specified, color chart representing manufacturer's full range of available colors.

- E. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- F. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- G. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
- H. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- I. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Filters: Two sets of each type and size.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## 1.7 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide 5 year manufacturer's warranty for condensing unit components, including but not limited to compressor failure or condenser coil leaks.

## PART 2 PRODUCTS

### 2.1 HYDRONIC UNIT HEATERS

- A. Manufacturers:
  - 1. Airtherm, a Mestek Company.
  - 2. Daikin Applied.
  - 3. Modine Manufacturing Company.
  - 4. Sigma Convector Enclosure Corporation.
  - 5. Sterling Hydronics, a Mestek Company.
  - 6. Trane Technologies, PLC.
  - 7. Vulcan Radiator, a Mestek Company.
  - 8. Zehnder Rittling.
- B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
  - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
  - 2. Heating Hot Water: Suitable for working temperatures up to a maximum not less than 320 degrees F and working pressures of 200 psig minimum.
  - 3. Provide drain valve and manual air vent.
- C. Perform factory run test under normal operating conditions and water flow rates.
- D. Casing: Minimum 20 gauge, 0.0359 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 20 gauge, 0.0359 inch thick sheet steel top and bottom plates for vertical projection models.
- E. Finish: Factory applied baked enamel of manufacturer's standard color.
- F. Fan: Direct drive propeller type, statically and dynamically balanced, with OSHA-compliant fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- G. Air Outlet: Adjustable pattern diffuser on vertical projection models and two- or four- way louvers on horizontal projection models.



- H. Totally Enclosed Motors: Single speed, permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models. Comply with requirements in 23 05 13.
- I. Thermostatic Controls: Local wall-mounted thermostat.

## 2.2 HYDRONIC CABINET UNIT HEATERS

- A. Manufacturers:
  - 1. Airtherm, a Mestek Company.
  - 2. Daikin Applied.
  - 3. Modine Manufacturing Company.
  - 4. Sigma Convector Enclosure Corporation.
  - 5. Sterling Hydronics a Mestek Company.
  - 6. Trane Technologies, PLC.
  - 7. Vulcan Radiator, a Mestek Company.
  - 8. Zehnder Rittling.
- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
- C. Coils:
  - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
  - 2. Heating Hot Water: Suitable for working temperatures up to a maximum not less than 220 degrees F and working pressures of 200 psig minimum.
  - 3. Provide drain valve and manual air vent.
- D. Vertical Cabinet and Horizontal Exposed: Minimum 18 gauge, 0.0478 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, 1/2 inch glass fiber or closed-cell foam insulation, integral air outlet, and inlet grilles. For vertical cabinet units, fabricate front panel of minimum 16 gauge, 0.0598 inch thick sheet steel.
  - 1. On vertical and horizontal cabinet units provide tamperproof locks.
- E. Horizontal Recessed Units: Provide with a galvanized steel cabinet, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles with minimum 18 gauge, 0.0478 inch thick sheet steel bottom panel.
  - 1. Provide tamperproof locks.
  - 2. Where partial-recessed units are required (refer to drawings) provide factory projection panels to match unit cabinet color and finish.
- F. Concealed Units:
  - 1. Provide with a galvanized steel cabinet, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles with minimum 18 gauge, 0.0478 inch thick sheet steel bottom panel.
- G. Finish: Factory applied baked enamel in manufacturer's standard colors, to be selected by architect, on visible surfaces of enclosure or cabinet.
- H. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- I. Motor: Tap wound variable speed ECM with sleeve bearings, resiliently mounted. Comply with requirements in 23 05 13.
- J. Thermostatic Controls: Manufacture unit-mounted, low voltage, electromechanical thermostat to maintain temperature setting.
  - 1. System selector switch (heat-off) and fan control switch (auto-on).
- K. Fan Control: Factory wired, solid state, infinite speed control, located in cabinet.
- L. Filter: Easily removed, 1 inch thick, glass fiber throw-away MERV 8, located to filter air before coil. See Section 23 40 00.

- M. Electrical Characteristics:
1. Disconnect Switch: Factory-installed disconnect switch.
  2. Factory-installed single-point power connection.

## 2.3 BLOWER-COIL UNITS

- A. Manufacturers:
1. Carrier Corporation.
  2. Daikin.
  3. Johnson Controls International, PLC.
  4. IEC.
  5. Trane Technologies, PLC.
- B. Performance Data and Safety Requirements:
1. Changeover bypass Coils rated and tested in accordance with AHRI 410 per drawings.
  2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for purpose indicated.
  3. Comply with NFPA 90A for unit construction, including filters and related equipment, for protection of life and property from fire, smoke, and gases resulting from conditions having manifestations similar to fire.
- C. Unit Casing:
1. Fabricate from heavy gauge galvanized steel sheet.
  2. Insulate inside walls with 1 inch thick, fiberglass insulation for thermal and acoustical control, double-wall construction.
  3. Provide access panels allowing servicing of coils, drain pan, fan, motor, and drive.
  4. Provide knockouts or hanger rod holes at all four corners for suspended units.
- D. Air Coils:
1. Aluminum fins mechanically expanded or bonded to copper tubes having standard sweat connections.
    - a. Hydronic: Designed to a working pressure and temperature of not less than 250 psig and 200 degrees F. Include drain valve and manual air vent.
- E. Fans: Forward curved, centrifugal blower, double width, dynamically balanced, direct drive with fan shaft supported by heavy-duty, permanently sealed ball bearings.
- F. Drain Pan: Cleanable, one-piece construction of stainless steel; with drain connection and sloped for positive drainage and condensate overflow switch.
- G. Filters: Fully accessible, flat filter rack with two-inch MERV 8 according to ASHRAE Std 52.2.
- H. Motors: Multiple speed ECM with sleeve or ball bearings, resiliently mounted, permanently lubricated with thermal overload protection. Motors will soft ramp between speeds to lessen the acoustics due to sudden speed changes. Maximum ambient operating temperature of 104 deg F. See Section 23 05 13.
- I. Accessories:
1. Leak Detection Sensor: Unit shall be furnished with a leak detection system from the factory when a circuit refrigerant charge exceeds 3.91 lbs. The leak detection system shall consist of one or more refrigerant detection sensors; upon sensing a leak, the unit controller shall initiate mitigation actions. The automatic temperature controls contractor shall be responsible for programming, refer to 23 09 93 for more details.
- J. Controls:
1. Control valves and control devices to be furnished and installed by the automatic temperature controls manufacturer. Control devices and control sequences to comply with requirements in Section 23 09 13 and Section 23 09 93 .
  2. Blower Coil Unit Manufacturer's Controls & Controls Interface:
    - a. 24-volt control circuit transformer.

- b. Motor circuit fusing.
- c. Fan contactor.
- d. Terminal strip for connection of field wiring and integration to existing BMS.
- e. Disconnecting means for main incoming power.

K. Electrical Characteristics:

- 1. Disconnect Switch: Factory-installed disconnect switch located on cabinet.
- 2. Factory-installed single-point power connection.

## 2.4 COIL PIPING PACKAGES

A. Manufacturers:

- 1. Bell and Gossett.
- 2. Griswold Controls.
- 3. Nibco.
- 4. Pro Hydronic Specialties.
- 5. Trane Technologies, PLC.

B. Description: Integral assembly, refer to individual components requirements below. On return-side, provide isolation ball valve, manual balancing valve, combination pressure/temperature port, and manual air vent. On supply-side, provide isolation ball valve, integrated Y strainer, combination pressure/temperature port, manual air vent, and drain valve.

C. General:

- 1. Maximum assembly pressure drop: 5 feet.
- 2. Maximum assembly working pressure at 250 degrees F: 200 psi.

D. Manual Balancing Valves:

- 1. Brass or Bronze body for shutoff and hydronic balancing.
- 2. Brass venturi insert and graduated memory stop.

E. Ball Valves:

- 1. Brass or Bronze body for shutoff and hydronic balancing.
- 2. Provide combination pressure/temperature port(s).
- 3. Provide manual balancing valve with brass venturi insert and graduated memory stop.

F. Y Strainers:

- 1. Bronze body.
- 2. "Y" type configuration with brass cap.
- 3. Maximum Operating Pressure: Minimum 450 psi.
- 4. Screen: Stainless steel, 20 mesh.

G. Drain Valve:

- 1. Brass or Bronze housing with 3/4" hose connection with cap.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that available power supply complies with equipment specifications.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Ensure electric utility connections are achieved in an orderly and expeditious manner.
- C. Verify that equipment is undamaged, including shipped loose items.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.

- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Unit Heaters:
  - 1. Install units level and plumb.
  - 2. Hang from building structure, with pipe hangers anchored to supplementary structure, not from piping or electrical conduit.
  - 3. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
  - 4. Comply with requirements in 23 05 48.
- E. Cabinet Unit Heaters:
  - 1. Install units level and plumb.
  - 2. Coordinate to ensure correct recess size for recessed units; install in finished wall assembly and seal and weatherproof.
  - 3. Comply with requirements in 23 05 48.
- F. Units with Hydronic Coils:
  - 1. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping. Refer to details on drawings.
  - 2. If not easily accessible, extend air vent to exterior surface of cabinet for ease of servicing.
  - 3. Provide float operated automatic air vents with stop valve for cabinet unit heaters, fan coil units, and unit heaters.
- G. Blower-Coil Units:
  - 1. Verify all surfaces and openings at unit location can suitably accommodate unit(s).
  - 2. Install in accordance with manufacturer's recommendations.
  - 3. Install units level and plumb.
  - 4. Provide manual shut-off valve on hydronic supply side of coil and balancing valve with memory stop on return side.
  - 5. General piping installation requirements are specified in other Sections and drawings indicate general arrangement of piping, fittings, and specialties.
  - 6. Connect steam, hydronic, steam condensate, condensate drain, and overflow drain piping to unit.
  - 7. Comply with requirements in 23 05 48.
  - 8. Comply with requirements in 23 23 00.
- H. Air Coils:
  - 1. Install in ducts and casings in accordance with SMACNA (DCS).
    - a. Support coil sections independent of piping on steel channel or double angle frames and secure to casing.
    - b. Provide frames for maximum of three coil sections.
    - c. Arrange supports to avoid piercing drain pans.
    - d. Provide airtight seals between coil and casing or duct.
    - e. See Section 23 31 00.
  - 2. Coil Safeguards:
    - a. Protect coils to prevent damage to flanges and fins.
    - b. Comb out damaged fins.
  - 3. Install all coils level except cleanable coils with 1:50 pitch.
  - 4. Make connections to hydronic and steam coils with unions and flanges.
  - 5. Hydronic (Drainable) Coils:
    - a. Connect water supply to leaving air side of coil (counterflow arrangement).
    - b. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping.
    - c. Locate supply water connection on leaving air side at bottom of supply header, and return water connection at top.
    - d. Provide manual air vents with stop valves at high points.

- 1) Install drain connections at low points of installation.
6. Cooling Coils:
  - a. Provide three break or six break moisture eliminators of galvanized 24 gauge, 0.0239 inch sheet steel, where air velocity exceeds 500 ft/min.
  - b. Cooling Condensate Drain Pan and Drain Connection:
    - 1) Fabricate from galvanized 20 gauge, 0.0359 inch sheet steel, extend 3 inches from face of entering air side, 6 inches from the face of the leaving air side, and 4 inches from the face of moisture eliminators.
    - 2) Design slope in accordance with ASHRAE Std 62.1 and install to prevent standing water.
    - 3) Pipe drains individually to floor drain with water seal trap.
  - c. Install condensate drain pan under each main cooling coil and intermediate condensate drain pan at each level of stacked cooling coils to collect all condensate from coil assembly, pipe header, pipe return bends, upstream run-off, and downstream carry-over.

### 3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform and document the following:
  1. Leak Test: Charge system to test for leaks after installation; repair leaks as required and retest until complete.
  2. Operational Test: Start units and verify unit operation, motor rotation, and actuation of any components.
  3. Safety and Controls Test: Test and adjust any safeties or controls; repair and replace components if required.
- C. Provide access and coordination time as required to accommodate timely performance.

### 3.5 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.
- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- E. Install new filters.

### 3.6 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation to equipment to Owner's designated representative(s).
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
  1. Use operation and maintenance data as reference during demonstration.
  2. Conduct walking tour of project.
  3. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
  1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required. All training shall be video recorded for Owner's usage.
  2. Provide minimum of two hours of training.
  3. Instructor: Manufacturer's training personnel.
  4. Location: At project site.

### 3.7 PROTECTION

- A. Provide finished cabinet units with protective covers during the balance of construction.



**END OF SECTION**

## SECTION 26 01 26 - MAINTENANCE TESTING OF ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section includes:
  - 1. Provide a complete infrared thermal imaging (or thermographic) inspection for all electrical distribution equipment as shown on the electrical drawings and/or on the electrical one-line diagram.
  - 2. The thermal imaging inspection shall be conducted to detect poor connections, overloaded components and any other hot spots which can be detected as infrared radiation, which when left unattended might cause an unscheduled power interruption.

#### 1.2 REFERENCESTANDARDS

- A. NFPA 70, National Electrical Code
- B. NFPA 70B, Recommended Practice for Electrical Equipment Maintenance
- C. NFPA 70E, Standard for Electrical Safety in the Workplace
- D. ANSI/NETA (InterNational Electrical Testing Association) Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems

#### 1.3 CLOSEOUT SUBMITTALS

- A. Prepare a certified report (including photo recording) identifying all connections checked and describing results of scanning. Include the following:
  - 1. inspection date and time
  - 2. thermal imaging equipment used
  - 3. ambient temperature at each location
  - 4. one infrared photograph of the equipment with hot spot areas identified by the test
  - 5. an overall color photograph of the equipment indicating the physical location of the detected hot spots
  - 6. a close-up infrared and color photograph of each hot spot detected
  - 7. description of deficiencies detected with interpretation and explanations, recommendations, and other relevant information
  - 8. description of any remedial action taken

#### 1.4 QUALITY ASSURANCE

- A. Contractor or Subcontractor performing the infrared thermal imaging inspection shall be an electrical apparatus service company experienced in the methods of infrared thermal imaging inspection for electrical equipment and be routinely engaged in this type of work.
- B. Contractor and any Subcontractors shall be licensed and insured.
- C. The Contractor or Subcontractor shall be approved by the Owner and Engineer prior to the start of the work.

### PART 2 - PRODUCTS

#### 2.1 TESTING EQUIPMENT

- A. Use a portable infrared (IR) thermal imaging device designed to measure temperature or detect significant deviations (greater than 5 degrees Fahrenheit above ambient) from normal values and provide photo recording. Provide calibration record for scanning device.

### PART 3 - EXECUTION

#### 3.1 FIELD QUALITY CONTROL

- A. Test Procedure
  - 1. After substantial completion, but not more than thirty (30) days after final acceptance, perform an infrared thermal imaging scan of equipment and connections.



2. Electrical power equipment shall be tested under at least 40% of nominal load. Exact times shall be selected with the approval of the Owner. Maximum load conditions are ideal, if possible.
  3. Remove equipment covers and dead fronts (without taking the equipment out of service) to make joints and connections accessible to the imaging device.
  4. Scan shall pinpoint the component responsible for the heat generation. Sources may include:
    - a. Three-phase imbalance
    - b. Loose, over-tightened, or corroded connections with increased resistance on bus bars and wiring, broken or undersized wires, and/or defective insulation, located:
      - 1) at or in equipment
      - 2) feeder splices
    - c. Circuit breakers or fuses that are overloaded, imbalanced, open, or defective
    - d. Disconnect switches
    - e. Motor starters and motor control centers
    - f. Transformers
    - g. Wherever the difference in temperature (DT) between similar components under similar loads exceeds 25 degrees Fahrenheit, which would indicate the need for immediate repairs.
  5. Follow-up infrared scanning: Perform two additional follow-up infrared scans of the same equipment, connections and splices, one shall be four (4) months after substantial completion, and one shall be eleven (11) months after substantial completion.
- B. Safety
1. Electrical test and measurement safety standards shall be as defined in NFPA 70E.

### 3.2 ADJUSTING

- A. Connections added, relocated, removed, or otherwise affected by the scope of this project and new equipment:
1. The Contractor shall correct all defects revealed by the testing procedures, and additional tests shall be made until all defects have been eliminated.
  2. Documentation showing the conditions before and after the corrective work shall be furnished to the Owner.
- B. Existing equipment not involved in the scope of this project:
1. The Contractor identify the cause of all defects revealed by the testing procedures and report the findings in writing to the Owner.

**END OF SECTION**



## SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. Requirements generally applicable to the Work specified in Divisions 26, 27, and 28. This Section is also referenced by related Work specified in other Divisions.
  - 2. Field conditions and other facility performance requirements applicable to Work specified in Divisions 26, 27, and 28 .

#### 1.2 REFERENCE STANDARDS

- A. National Electrical Contractors Association (NECA)
  - 1. NECA 1: Standard Practice of Good Workmanship in Electrical Construction
  - 2. NECA 90: Standard for Commissioning Building Electrical Systems
  - 3. NECA 200: Standard for Installing and Maintaining Temporary Electric Power at Construction Sites

#### 1.3 ACTION SUBMITTALS – GENERAL

- A. Approval of equipment, fixtures, methods, etc. proposed as alternates to those called for in the plans may be obtained by the following process. Consideration of alternate equipment shall be solely at the discretion of the Engineer. No alternates to the plans and specifications will be accepted except those given prior approval as follows.
  - 1. All proposed alternate equipment, fixtures, methods, etc. must be submitted for approval not less than ten (10) days prior to bid due date. Submittals shall be equivalent to those required for review as noted in Part B below.
  - 2. After review of the submittals the Engineer will determine acceptability of alternate proposals. All acceptable alternates will be made known to prospective contractors through the means of communication deemed best by the Engineer.
- B. Submit all materials and equipment for review. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment as follows:
  - 1. Submit schematics and connection diagrams for all electrical equipment. A manufacturer's standard connection diagram or schematic showing more than one scheme of connection will not be accepted unless it is clearly marked to show the intended connections. Sequence of operation shall be worded to indicate the progression of operation of all pushbuttons, limit switches, relays, solenoids, and all other control devices.
  - 2. Equipment and materials descriptive literature not readily cross-referenced with the drawings or specifications shall be identified by a suitable notation.
  - 3. Lighting fixture descriptive sheets shall show the fixture schedule letter, number, or symbol for which the sheet applies.
  - 4. Sheets or drawings showing more than the particular item under consideration shall have crossed out all but the pertinent description of the item for which review is requested.
  - 5. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies.
  - 6. The Contractor shall submit within thirty (30) days of the award of the contract for the Engineer's review for compliance with the construction documents and prior to any purchase of the items: materials, equipment, devices (including outlets and switches), conduit and wire, and fixtures proposed to be incorporated within the work. Where manufacturers are indicated for an item in the specification, only designation by catalog number of the manufacturer of the item to be used shall be required. All other items shall be listed with catalog numbers and descriptive information. The list must be complete to receive consideration. Items judged by the Engineer to be in non-conformance may be rejected. Shop Drawings of panelboards, switches over 35 amp rating, and special equipment will be required prior to their approval.

#### 1.4 CLOSEOUT SUBMITTALS – GENERAL

- A. Submit the following within 30 days of project completion as required by the Indiana Energy Code:
  - 1. As-built record drawings
  - 2. Complete Operations & Maintenance (O&M) manuals
- B. Submit a certified copy of the inspection report.

#### 1.5 DRAWINGS

- A. Drawings and specifications are provided for assistance of the Contractor and are diagrammatic only to indicate the general arrangement and location of circuits, outlets, etc. Exact locations will be governed by the building and site where dimensioned. Deviations from the arrangement indicated to meet field conditions shall be made with no expense to the Owner.
- B. The location of outlets and connections for equipment to be installed by others are indicated on the plans; verify these locations with the party responsible for installing such equipment.
- C. Throughout the progress on construction, the Contractor shall keep a set of detailed field record drawings, including the exact location of concealed work and underground utilities. This requirement does not authorize any deviations from the Contract Drawings without prior approval from the Engineer. The field record information shall be marked in a legible manner on prints of the drawings. At the completion of work, the Contractor shall deliver the field record information to the Engineer.
- D. The contractor may choose to obtain CAD file versions of the drawings to assist in documentation (i.e. fire alarm system submittals, occupancy sensor layouts, etc.). Refer to specification 01 00 01 - Electronic Model/Drawing File Exchange Agreement. The contractor shall include costs in their base bid to obtain these proprietary drawings from GMB Architecture+Engineering if required by that section.

#### 1.6 CODES AND STANDARDS

- A. These specifications are minimum requirements and shall govern except where made more stringent by other Sections of this specification or local, state, or federal laws or regulations. Where conflict between drawings, specifications, codes, or standards occurs, the more stringent requirements shall govern. No extra compensation for such compliance will be allowed.
- B. Submission of proposal is considered evidence that the Contractor is proficient and experienced, and knowledgeable of all standards, codes, ordinances, permits, and regulations affecting his work.

#### 1.7 QUALITY ASSURANCE

- A. The Contractor shall obtain all necessary permits and shall pay all fees in connection with all permits, inspections, and approval by the proper authorities in local jurisdiction of such work. Final inspection by the Engineer will not occur until necessary certificates of satisfactory inspection are received.

#### 1.8 CLEARANCES

- A. Equipment: Maintain working clearances around electrical equipment as required for proper maintenance and operation, as required by NEC.

#### 1.9 TEMPORARY POWER

- A. The Electrical Contractor shall provide all labor and material for temporary power and lighting required in construction for all trades until the permanent system is in operation. Power for welding machines, terrazzo grinders, and other high current drawing machines will not be supplied. Each contractor will be required to supply his own portable power source for these machines.



- B. Temporary building services required for occupied areas not under construction shall comply with NEC. Service capacity shall be adequate to ensure continuity of building operations.
- C. The Electrical Contractor shall include the following facilities in the temporary power and lighting service for the entire project:
  - 1. Use existing electrical distribution system as needed.
  - 2. For general temporary lighting in construction areas, provide an average maintained level of not less than 10fc. Provide not less than 1500 lumen (minimum) lamps in corridors and similar traffic ways, spaced not more than 50 feet apart, and provide one (1) lamp at each stairway or ladder landing.
  - 3. For general use of power hand tools and task lighting, provide temporary 4-gang outlets so that each area of work can be reached with a 100 foot extension cord. Provide separate, 120V, 20-amp circuit for each two 4-gang outlets (8 outlets per circuit). All temporary receptacles shall be GFCI protected as required by the NEC.
- D. Temporary lighting system shall be circuited and controlled so that the lighting level in each portion of the building can be reduced to provide security lighting during non-working hours and on weekends and holidays. The level of lighting for security purposes shall be in accordance with all federal, state, and local regulations. The Electrical Contractor shall be responsible for the control of the temporary lighting such that the lighting is turned on at the beginning of each workday and the normal working lighting is reduced to the security lighting level at the end of each workday.
- E. After installation of the permanent lighting system, it may be used for construction lighting as required. The electrical contractor shall ensure that all fixtures are operable and cleaned to new condition at the conclusion of construction.
- F. The owner will pay for all electrical current used for temporary light and power.
- G. Complete installation shall comply with all applicable codes.
- H. Electrical Contractor's bid shall allow for removal and salvage of any temporary service when it is no longer required.

#### **1.10 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery:
  - 1. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable. Do not use damaged or expired materials.
  - 2. Upon delivery to the project site, inspect all products and materials for any damage. Acceptance of the units constitutes that the inspection has occurred, and no damaged or unacceptable products were found. Replacement of any damaged or unacceptable products shall be the responsibility of the contractor.
- B. Storage: Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.
- C. Handling: Protect materials during handling and installation to prevent damage.

#### **1.11 FIELD CONDITIONS**

- A. Equipment shall not be subjected to dust, debris, moisture, or temperature and humidity conditions exceeding the requirements indicated above or as marked on the product, at any point prior to installation. Only properly rated equipment and enclosures, installed per the manufacturer's instructions, shall be subjected to dust and moisture following installation.
- B. Do not install electrical equipment and components until the manufacturers' indicated operating temperature and relative humidity can be maintained in locations to receive equipment.

## 1.12 WARRANTY

- A. Installing contractor shall guarantee all labor, materials, and equipment in writing for one year after final acceptance date and/or normal continuous complete season's operation applicable to equipment or system.
- B. Acceptance date shall be determined by Architect/Engineer and stated in writing. Contractor shall secure equal guarantees from suppliers.
- C. Contractor shall make all necessary alterations, repairs, adjustments, and replacements during guarantee period as directed by Architect/Engineer to comply with Contract Documents, at no cost to the Owner.
- D. Repair or replacements made under the guarantee provision shall bear further one-year guarantee from date of acceptance of repair or replacement.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory and Standards Requirements
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory, and marked for intended location and application.
  - 2. Comply with applicable federal, state, and local codes for work of this nature and with requirements of the Authority Having Jurisdiction (AHJ).
  - 3. Comply with ADA.
  - 4. Comply with NFPA 70 and NFPA 101.
- B. Up-to-Date Products: Equipment and components shall be new and the manufacturer's current model.

### 2.2 MATERIALS

- A. Products shall be by established manufacturers regularly engaged in making type of materials to be provided and complete with all parts, accessories, trimmings, connections, etc. reasonably incidental thereto as specified in detail or as described in manufacturer's catalog. All equipment shall be properly cleaned, adjusted, and put in complete working order ready for service.
- B. All packaged equipment shall be completely factory wired prior to delivery to the job site. Connection to and bonding of this equipment is required under this Division of the specifications.
  - 1. The Contractor shall check all prewired controls before energizing to verify that all internal wiring is properly coordinated to the voltage to be applied.
  - 2. The General Equipment Requirements shall apply to all equipment furnished under this Division.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Contractor shall be responsible for all start-up procedures and system checks.
- B. All equipment shall be installed, tested, and operated in accordance with respective manufacturer's recommendations.

### 3.2 INSTALLATION

- A. Regulatory and Standards Requirements
  - 1. Comply with applicable federal, state, and local codes for work of this nature and with requirements of the Authority Having Jurisdiction (AHJ).
  - 2. ADA Compliance: Comply with ADA.
  - 3. NFPA Compliance: Comply with NFPA 70, NFPA 70E , and NFPA 101.

4. NECA Compliance: Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with NECA 1.
  5. Consult Architect for resolution of conflicting requirements.
- B. The Contractor shall provide and install all equipment as specified, required, or implied in this specification except as noted. This requirement shall include all labor, materials, and incidentals in a manner consistent with good practice necessary for a complete operable installation.
  - C. The Contractor shall implement cooperation with other trades by his reference to the Architectural and Mechanical Drawings and other Sections of the specifications for work by other trades and to be carried on simultaneously or sequentially with the electrical work. This requirement is to facilitate construction to proceed with no harm to the Owner due to the absence of cooperation. All other Drawings and Sections of the specifications shall become part of the electrical specifications as they relate to electrical work.
  - D. The Contractor shall verify equipment dimensions to insure dimensional compatibility.
  - E. Contractor shall provide services of one or more experienced superintendents in charge of all required personnel continuously when work is being performed on the project site.
  - F. No work shall be covered or enclosed until work is tested in accordance with applicable Codes and Regulations and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by Contractor and shall be submitted to Architect/Engineer before final acceptance of work.
  - G. The Electrical Contractor shall do all cutting and patching necessary for the installation of electrical work and all such cutting and patching shall be done with the approval and under the supervision of the Architect/Engineer.
  - H. Cutting or patching shall not impair the strength or function of work being cut, i.e., structural members shall not be weakened and holes through exterior walls and ground floor shall be waterproofed. Use rotary type drilling tools and concrete cutting saws to cut concrete and masonry walls. Do not use torches for cutting steel. No structural members shall be cut without prior approval of the Architect/Engineer.
  - I. The Electrical Contractor shall be responsible for repairs and finish of all holes placed for conduit if such holes are placed after general construction is completed.
  - J. All equipment wiring shall be installed in accordance with shop drawings to be furnished by the supplier of the equipment. Where necessary, circuits shall be adjusted in size to match equipment being furnished.
  - K. All excavation, backfilling, and concrete work shall conform to the respective Sections of these specifications.
  - L. Mounting heights unless otherwise noted shall be from the finished floor to the bottom of the device.
  - M. Circuits for different types of signals shall be run in separate conduits, i.e., 120v, 4-20 ma, thermocouple, and pulse circuits shall be grouped in their own conduits.
  - N. The Electrical Contractor shall be responsible for providing all conduit and wiring for the interconnections of mechanical equipment. The Contractor should refer to the mechanical specifications to determine work of this kind that will be handled by others.
  - O. The Contractor shall provide 4 feet x 8 feet x 3/4 inch plywood backboards on the walls in each telecommunications room for mounting of communications equipment and cable management.
  - P. Provide one (1) 4-11/16 inch square by 2-1/8 inch deep box with single gang device ring and single gang plate at communications outlet locations indicated on Drawings, unless otherwise indicated. Run two (2) empty 2 inch conduits from each box to above accessible ceiling space.

### 3.3 FIELD QUALITY CONTROL

- A. During construction, conduct the following tests on the electrical installation:

1. Test the ground system.
  2. Check motors for proper rotation.
  3. Refer to Section 26 24 13 - Switchboards for switchboard and ground fault protection equipment.
- B. Upon completion of project, conduct the following tests on the electrical installation:
1. Adjust all voltage taps on transformers for an optimum operating level.
  2. Measure load balance on all panelboards and reconnect loads as may be necessary to obtain a reasonable balance of load on phases.
  3. Aim all adjustable lighting fixtures.
  4. Adjust all auxiliary systems for optimum performance.

### **3.4 SYSTEM STARTUP**

- A. The Electrical Contractor shall provide electricians to assist with the equipment start-up, including but not limited to, the following:
1. Vacuum and blow out all electrical panels.
  2. Change motor rotation as required.
  3. Exchange wires on terminal strips.
  4. Increase overload element sizes when required by the engineer.
  5. Measure and record all motor-running currents.
  6. Correct all wiring errors.

### **3.5 INSPECTION**

- A. Upon completion of the work described under these specifications and drawings, the Electrical Contractor shall obtain and pay for inspection and approval by the electrical inspecting authority. One (1) certified copy of the inspection report shall be delivered to the Architect/Engineer.

### **3.6 CLEANING**

- A. Daily remove from the site all debris and rubbish accumulating as a result of the electrical installation. Upon completion of the project, dispose of all debris and rubbish and leave manholes and electrical equipment rooms broom clean. Clean the interiors of all cabinets, pull boxes, and equipment enclosures.

### **3.7 OPERATING INSTRUCTIONS**

- A. Provide with all major items of equipment two (2) bound sets of operating and maintenance instructions to Engineer.
- B. For items where training is specified, provide service of factory-trained personnel for not less than two (2) separate days to instruct and train Owner's operating personnel.

### **3.8 DISCREPANCIES**

- A. In the event of discrepancy, immediately notify the Architect/ Engineer.
- B. Do not proceed with the installation in areas of discrepancies until all such discrepancies have been fully resolved.

### **3.9 PROTECTION**

- A. Protection: Equipment shall be constructed and packaged to withstand all stress induced in transit and during installation.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect/Engineer and at no additional cost to the Owner.

**END OF SECTION**

## SECTION 26 05 05 - SELECTIVE DEMOLITION FOR ELECTRICAL

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Electrical demolition.

### PART 2 PRODUCTS

#### 2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Architect before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

#### 3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Maintain existing system in service until new system is complete and ready for service.
  - 2. Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
  - 3. Make temporary connections to maintain service in areas adjacent to work area.

#### 3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.



- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

### **3.4 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

**END OF SECTION**



## **SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.
- G. Cable ties.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 05 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
- F. Section 28 46 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.
- E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers.
- F. ASTM B801 - Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation.
- G. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- I. NECA 104 - Standard for Installing Aluminum Building Wire and Cable.
- J. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable.
- K. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
- L. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.
- M. NFPA 70 - National Electrical Code.

- N. UL 44 - Thermoset-Insulated Wires and Cables.
- O. UL 83 - Thermoplastic-Insulated Wires and Cables.
- P. UL 267 - Outline of Investigation for Wire-Pulling Compounds.
- Q. UL 486A-486B - Wire Connectors.
- R. UL 486C - Splicing Wire Connectors.
- S. UL 486D - Sealed Wire Connector Systems.
- T. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
- U. UL 1569 - Metal-Clad Cables.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Field Quality Control Test Reports.

#### **1.5 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.1 CONDUCTOR AND CABLE APPLICATIONS**

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is permitted only as follows:
  - 1. Where not otherwise restricted, may be used:
    - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      - 1) Maximum Length: 6 feet.
    - b. Where installed in unfinished spaces, such as mechanical or electrical rooms, installed between the fixture and a junction box of a hard pipe conduit system.
      - 1) Maximum Length: 6 feet.
    - c. Projector Receptacle Whips: Whips for ceiling mounted receptacles installed in accessible ceilings intended for use with projectors and concealed above accessible ceilings. Include a service loop unless otherwise noted in specifications or drawings.
      - 1) Minimum Length for service loop: 10 feet.
    - d. Existing MC Cable Lighting Circuits: Where extending an existing lighting circuit composed of daisy-chained MC cable to new light fixtures installed in the same space or in the existing light fixture locations.

- e. Cable Fished Through Existing Walls: Where fishing power cable through an existing wall from a junction box of a hard pipe conduit system.
  - f. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
2. In addition to other applicable restrictions, may not be used:
- a. Where exposed to view.
  - b. Where exposed to damage.
  - c. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

## 2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:
  1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
    - a. Substitution of aluminum conductors for copper is permitted, when approved by Owner and authority having jurisdiction, only for the following:
      - 1) Services: Copper conductors size 1/0 AWG and larger.
      - 2) Feeders: Copper conductors size 1/0 AWG and larger.
    - b. Where aluminum conductors are substituted for copper, comply with the following:
      - 1) Size aluminum conductors to provide, when compared to copper sizes indicated, equivalent or greater ampacity and equivalent or less voltage drop.
      - 2) Increase size of raceways, boxes, wiring gutters, enclosures, etc. as required to accommodate aluminum conductors.
  2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  3. Tinned Copper Conductors: Comply with ASTM B33.
  4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- H. Minimum Conductor Size:
  1. Branch Circuits: 12 AWG.
- I. Conductor Color Coding:
  1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
  2. Color Coding Method: Integrally colored insulation.
  3. Color Code:
    - a. 208Y/120 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.

- b. Equipment Ground, All Systems: Green.

## 2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
  - 1. Copper Building Wire:
    - a. Cerro Wire LLC: [www.cerrowire.com/#sle](http://www.cerrowire.com/#sle).
    - b. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
    - c. General Cable Technologies Corporation: [www.generalcable.com/#sle](http://www.generalcable.com/#sle).
    - d. Service Wire Co: [www.servicewire.com/#sle](http://www.servicewire.com/#sle).
    - e. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
  - 1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
  - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

## 2.4 METAL-CLAD CABLE

- A. Manufacturers:
  - 1. AFC Cable Systems Inc: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  - 2. Encore Wire Corporation: [www.encorewire.com/#sle](http://www.encorewire.com/#sle).
  - 3. Service Wire Co: [www.servicewire.com/#sle](http://www.servicewire.com/#sle).
  - 4. Southwire Company: [www.southwire.com/#sle](http://www.southwire.com/#sle).
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
  - 1. Size 10 AWG and Smaller: Solid.
  - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide dedicated neutral conductor for each phase conductor.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Armor: Steel, interlocked tape.
- I. Provide PVC jacket applied over cable armor.

## 2.5 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
  - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
  - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
  4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
  5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
  6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

## 2.6 ACCESSORIES

- A. Electrical Tape:
1. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- C. Wire Pulling Lubricant:
1. Listed and labeled as complying with UL 267.
  2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
  3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

### 3.2 INSTALLATION

- A. Circuiting Requirements:
1. Unless dimensioned, circuit routing indicated is diagrammatic.
  2. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  3. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
  4. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.

- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install aluminum conductors in accordance with NECA 104.
- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
  - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  - 2. Pull all conductors and cables together into raceway at same time.
  - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- I. Terminate cables using suitable fittings.
  - 1. Metal-Clad Cable (Type MC):
    - a. Use listed fittings.
    - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. Make wiring connections using specified wiring connectors.
  - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
  - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  - 3. Do not remove conductor strands to facilitate insertion into connector.
  - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
  - 5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
  - 6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Identify conductors and cables in accordance with Section 26 05 53.
- Q. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.



- R. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for services and feeders. The resistance test for parallel conductors listed as optional is not required.
  - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- C. Correct deficiencies and replace damaged or defective conductors and cables.

**END OF SECTION**





## SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

#### 1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.
- E. NFPA 70 - National Electrical Code.
- F. UL 467 - Grounding and Bonding Equipment.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Field quality control test reports.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

- D. Grounding System Resistance:
  - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
  - 2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- E. Grounding Electrode System:
  - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    - a. Provide continuous grounding electrode conductors without splice or joint.
    - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
  - 2. Ground Rod Electrode(s):
    - a. Space electrodes not less than 10 feet from each other and any other ground electrode.
  - 3. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- F. Service-Supplied System Grounding:
  - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
  - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- G. Bonding and Equipment Grounding:
  - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
  - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
  - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
  - 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    - b. Metal gas piping.

## 2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
  - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 2. Provide products listed and labeled as complying with UL 467 where applicable.

- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 05 26:
  - 1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:
      - 1) Use bare copper conductors where installed underground in direct contact with earth.
      - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
  - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
  - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
  - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
    - a. Exceptions:
      - 1) Use exothermic welded connections for connections to metal building frame.
  - 4. Manufacturers - Mechanical and Compression Connectors:
    - a. allG Fabrication: [www.allgfab.com/#sle](http://www.allgfab.com/#sle).
    - b. Burndy LLC: [www.burndy.com/#sle](http://www.burndy.com/#sle).
    - c. Harger Lightning & Grounding: [www.harger.com/#sle](http://www.harger.com/#sle).
    - d. nVent ERICO: [www.nvent.com/#sle](http://www.nvent.com/#sle).
    - e. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
- D. Ground Bars:
  - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
  - 2. Size: As indicated.
  - 3. Holes for Connections: As indicated or as required for connections to be made.
  - 4. Manufacturers:
    - a. allG Fabrication: [www.allgfab.com/#sle](http://www.allgfab.com/#sle).
    - b. Harger Lightning & Grounding: [www.harger.com/#sle](http://www.harger.com/#sle).
    - c. nVent ERICO: [www.nvent.com/#sle](http://www.nvent.com/#sle).
    - d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: [www.thermoweld.com/#sle](http://www.thermoweld.com/#sle).
- E. Ground Rod Electrodes:
  - 1. Comply with NEMA GR 1.
  - 2. Material: Copper-bonded (copper-clad) steel.
  - 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
  - 4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
  - 5. Manufacturers:
    - a. allG Fabrication: [www.allgfab.com/#sle](http://www.allgfab.com/#sle).
    - b. Galvan Industries, Inc: [www.galvanelectrical.com/#sle](http://www.galvanelectrical.com/#sle).
    - c. Harger Lightning & Grounding: [www.harger.com/#sle](http://www.harger.com/#sle).
    - d. nVent ERICO: [www.nvent.com/#sle](http://www.nvent.com/#sle).

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
  - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
  - 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
  - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 05 53.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION**

## SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 33.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 26 05 33.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 26 51 00 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- E. Section 27 05 29 - Hangers and Supports for Communications Systems.

#### 1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- D. MFMA-4 - Metal Framing Standards Publication.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- F. NFPA 70 - National Electrical Code.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
  - 2. Coordinate work to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
  - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
  - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 30 00.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Comply with the following. Where requirements differ, comply with most stringent.
    - a. NFPA 70.
    - b. Requirements of authorities having jurisdiction.
  2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
  3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
  4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Manufacturers:
    - a. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - d. HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
  2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  3. Conduit Clamps: Bolted type unless otherwise indicated.
  4. Products:
    - a. Gripple, Inc; Universal Bracket: [www.gripple.com/#sle](http://www.gripple.com/#sle).
    - b. Gripple, Inc; Fast Trak: [www.gripple.com/#sle](http://www.gripple.com/#sle).
    - c. Gripple, Inc; Universal Clamp (Threaded): [www.gripple.com/#sle](http://www.gripple.com/#sle).
    - d. Gripple, Inc; Low Profile Bracket Kits: [www.gripple.com/#sle](http://www.gripple.com/#sle).
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
1. Manufacturers:
    - a. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
    - d. HoldRite, a brand of Reliance Worldwide Corporation: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).
- D. Metal Channel/Strut Framing Systems:
1. Manufacturers:
    - a. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Atkore International Inc; Unistrut: [www.unistrut.us/#sle](http://www.unistrut.us/#sle).
    - c. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - d. Source Limitations: Furnish channel/strut and associated fittings, accessories, and hardware produced by single manufacturer.
  2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
  3. Comply with MFMA-4.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
  - a. Equipment Supports: 1/2-inch diameter.
  - b. Busway Supports: 1/2-inch diameter.
  - c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
  - d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
  - e. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
  - f. Outlet Boxes: 1/4-inch diameter.
  - g. Luminaires: 1/4-inch diameter.
- F. Anchors and Fasteners:
  1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
  2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  4. Hollow Masonry: Use toggle bolts.
  5. Hollow Stud Walls: Use toggle bolts.
  6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  7. Sheet Metal: Use sheet metal screws.
  8. Wood: Use wood screws.
  9. Plastic and lead anchors are not permitted.
  10. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
    - b. Comply with MFMA-4.
    - c. Channel Material: Use galvanized steel.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
  1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
  2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.



- H. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners in accordance with manufacturer's recommended torque settings.
- J. Remove temporary supports.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**



## SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Stainless steel rigid metal conduit (RMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Galvanized steel electrical metallic tubing (EMT).
- G. Stainless steel electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Liquidtight flexible nonmetallic conduit (LFNC).
- J. Reinforced thermosetting resin conduit (RTRC).

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 84 00 - Firestopping.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 1. Includes additional requirements for fittings for grounding and bonding.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.16 - Boxes for Electrical Systems.
- F. Section 26 05 33.23 - Surface Raceways for Electrical Systems.
- G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 21 00 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- I. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.

#### 1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).
- C. ASTM D1002 - Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal).
- D. ASTM D1598 - Standard Test Methods for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
- E. ASTM D1599 - Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- G. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- J. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit.

- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
- M. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series.
- N. NEMA TC 14.AG - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- O. NEMA TC 14.BG - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- P. NFPA 70 - National Electrical Code.
- Q. UL 1 - Flexible Metal Conduit.
- R. UL 6 - Electrical Rigid Metal Conduit-Steel.
- S. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel.
- T. UL 360 - Liquid-Tight Flexible Metal Conduit.
- U. UL 514A - Metallic Outlet Boxes.
- V. UL 514B - Conduit, Tubing, and Cable Fittings.
- W. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- X. UL 746C - Polymeric Materials – Use in Electrical Equipment Evaluations.
- Y. UL 797 - Electrical Metallic Tubing-Steel.
- Z. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel.
- AA. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit.
- BB. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds.
- CC. UL 2420 - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- DD. UL 2515 - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

#### **1.4 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2-inch (53 mm) trade size and larger.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.1 CONDUIT APPLICATIONS**

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
  - 1. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
  - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), or schedule 80 rigid PVC conduit where emerging from underground.
  4. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.
  5. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), or stainless steel electrical metallic tubing (EMT).
- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
1. Locations subject to physical damage include, but are not limited to:
    - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- J. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or stainless steel rigid metal conduit (RMC).
1. Locations subject to severe physical damage include, but are not limited to:
    - a. In mechanical rooms..
- K. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), or stainless steel electrical metallic tubing (EMT).
- L. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC) or stainless steel rigid metal conduit (RMC).
1. Exterior locations subject to severe physical damage include, but are not limited to:
    - a. Where exposed to vehicular traffic below 20 feet.
- M. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), or stainless steel electrical metallic tubing (EMT).

## 2.2 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.

- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
- C. Electrical Service Conduits: See Section 26 21 00 for additional requirements.
- D. Fittings for Grounding and Bonding: See Section 26 05 26 for additional requirements.
- E. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- F. Provide products listed, classified, and labeled as suitable for purpose intended.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
  - 1. Branch Circuits: 3/4-inch trade size.
  - 2. Branch Circuit Homeruns: 3/4-inch trade size.
  - 3. Control Circuits: 1/2-inch trade size.
  - 4. Underground, Exterior: 1-inch trade size.
- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

### 2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  - 1. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.com/#sle](http://www.alliedeg.com/#sle).
  - 2. Nucor Tubular Products: [www.nucortubular.com/#sle](http://www.nucortubular.com/#sle).
  - 3. Rymco USA: [www.rymcousa.com/#sle](http://www.rymcousa.com/#sle).
  - 4. Western Tube, a division of Zekelman Industries: [www.westerntube.com/#sle](http://www.westerntube.com/#sle).
  - 5. Wheatland Tube, a division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
  - 1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.us/#sle](http://www.alliedeg.us/#sle).
    - c. Bridgeport Fittings Inc: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
    - d. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
  - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
  - 3. Material: Use steel or malleable iron.
  - 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

### 2.4 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  - 1. Calbrite, a division of Atkore International: [www.calbrite.com/#sle](http://www.calbrite.com/#sle).
  - 2. Gibson Stainless & Specialty Inc: [www.gibsonstainless.com/#sle](http://www.gibsonstainless.com/#sle).
  - 3. Patriot Industries, a division of Patriot Aluminum Products LLC: [www.patriotsas.com/#sle](http://www.patriotsas.com/#sle).
  - 4. Rymco USA: [www.rymcousa.com/#sle](http://www.rymcousa.com/#sle).
- B. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.
  - 1. Material: Type 304 or 316 stainless steel.
- C. Fittings:
  - 1. Manufacturers:
    - a. Calbrite, a division of Atkore International: [www.calbrite.com/#sle](http://www.calbrite.com/#sle).
    - b. Eaton: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - c. Gibson Stainless & Specialty Inc: [www.gibsonstainless.com/#sle](http://www.gibsonstainless.com/#sle).

- d. Patriot Industries, a division of Patriot Aluminum Products LLC:  
[www.patriotsas.com/#sle](http://www.patriotsas.com/#sle).
2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
3. Material: Use stainless steel with corrosion resistance equivalent to conduit.
4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

## 2.5 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  1. ABB; Ocal: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
  2. Calbond, a division of Atkore International [www.calbond.com/#sle](http://www.calbond.com/#sle)
  3. Robroy Industries: [www.robroy.com/#sle](http://www.robroy.com/#sle).
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.
- D. PVC-Coated Boxes and Fittings:
  1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
  2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
  3. Material: Use steel or malleable iron.
  4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

## 2.6 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
  1. AFC Cable Systems, a division of Atkore International: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  2. Electri-Flex Company: [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  3. International Metal Hose: [www.metalhose.com/#sle](http://www.metalhose.com/#sle).
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
  1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Bridgeport Fittings, LLC: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
    - c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel or malleable iron.

## 2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
  1. AFC Cable Systems, a division of Atkore International: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  2. Electri-Flex Company: [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  3. International Metal Hose: [www.metalhose.com/#sle](http://www.metalhose.com/#sle).
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
  1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).

- b. Bridgeport Fittings, LLC: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
- c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.

## 2.8 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
  1. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.com/#sle](http://www.alliedeg.com/#sle).
  2. Nucor Tubular Products: [www.nucortubular/#sle](http://www.nucortubular/#sle).
  3. Rymco USA: [www.rymcousa.com/#sle](http://www.rymcousa.com/#sle).
  4. Western Tube, a division of Zekelman Industries: [www.westerntube.com/#sle](http://www.westerntube.com/#sle).
  5. Wheatland Tube, a division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
  1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.us/#sle](http://www.alliedeg.us/#sle).
    - c. Bridgeport Fittings, LLC: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
    - d. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Material: Use steel or malleable iron.
  4. Connectors and Couplings: Use compression/gland or set-screw type.
    - a. Do not use indenter type connectors and couplings.

## 2.9 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
  1. Calbrite, a division of Atkore International: [www.calbrite.com/#sle](http://www.calbrite.com/#sle).
- B. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.
  1. Material: Type 304 or 316 stainless steel.
- C. Fittings:
  1. Manufacturers:
    - a. Calbrite, a division of Atkore International: [www.calbrite.com/#sle](http://www.calbrite.com/#sle).
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  3. Connectors and Couplings: Use compression/gland or set-screw type.

## 2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
  1. ABB; Carlon: [www.carlon.com/#sle](http://www.carlon.com/#sle).
  2. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.com/#sle](http://www.alliedeg.com/#sle).
  3. Cantex Inc: [www.cantexinc.com/#sle](http://www.cantexinc.com/#sle).
  4. Heritage Plastics, a division of Atkore International: [www.heritageplastics.com/#sle](http://www.heritageplastics.com/#sle).
  5. JM Eagle: [www.jmeagle.com/#sle](http://www.jmeagle.com/#sle).
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected.
2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

### **2.11 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)**

- A. Manufacturers:
1. AFC Cable Systems, a division of Atkore International: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  2. Electri-Flex Company: [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  3. IPEX, a division of Aliaxis: [www.ipexna.com/#sle](http://www.ipexna.com/#sle).
- B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
- C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for type of conduit to be connected.

### **2.12 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)**

- A. Manufacturers:
1. Champion Fiberglass, Inc: [www.championfiberglass.com/#sle](http://www.championfiberglass.com/#sle).
  2. FRE Composites: [www.frecompositesinc.com/#sle](http://www.frecompositesinc.com/#sle).
  3. United Fiberglass of America, Inc: [www.unitedfiberglass.com/#sle](http://www.unitedfiberglass.com/#sle).
- B. Applications:
1. Underground, Direct-Buried: Use belowground (BG), DB (direct-burial) RTRC or aboveground (AG) RTRC.
  2. Underground, Embedded in Concrete: Use belowground (BG), EB (encased-burial) RTRC, belowground (BG), DB (direct-burial) RTRC, or aboveground (AG) RTRC.
- C. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
1. Aboveground (AG) RTRC: Comply with NEMA TC 14.AG and list and label as complying with UL 2515.
  2. Belowground (BG) RTRC: Comply with NEMA TC 14.BG and list and label as complying with UL 2420.
- D. Supports: As recommended by manufacturer.
- E. Fittings: Same type and manufacturer as conduit to be connected.

### **2.13 ACCESSORIES**

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- E. Adhesive for HDPE and RTRC Conduit:
1. Specifically designed for bonding dissimilar materials in lieu of transition fittings, including but not limited to polyethylene, fiberglass, PVC, aluminum, and steel; UL 746C recognized.
  2. Approved by adhesive manufacturer for use with materials to be joined.
  3. Adhesive Shear Strength: Not less than 100 psi, when tested in accordance with ASTM D1002.

4. Hydrostatic Pressure Resistance: No leaks, when tested in accordance with ASTM D1598 at 120 psi for 1,000 hours and when tested in accordance with ASTM D1599 at 250 psi.
5. Products:
  - a. American Polywater Corporation; Polywater BonDuit Conduit Adhesive: [www.polywater.com/#sle](http://www.polywater.com/#sle).
- F. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- G. Foam Conduit Sealant:
  1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
  2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
  3. Rated to hold minimum of 10 ft water head pressure.
  4. Products:
    - a. American Polywater Corporation; Polywater AFT Foam Duct Sealant: [www.polywater.com/#sle](http://www.polywater.com/#sle).
    - b. American Polywater Corporation; Polywater FST Foam Duct Sealant: [www.polywater.com/#sle](http://www.polywater.com/#sle).
- H. Conduit Mechanical Seals:
  1. Listed as complying with UL 514B.
  2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
  3. Suitable for sealing around conductors/cables to be installed.
  4. Products:
    - a. American Polywater Corporation; PHRD SG Mechanical Seals: [www.polywater-haufftechnik.com/#sle](http://www.polywater-haufftechnik.com/#sle).
- I. Sealing Systems for Concrete Penetrations:
  1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
  2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
  3. Products:
    - a. American Polywater Corporation; PZVR Cement-Coated Concrete Wall Sleeves: [www.polywater-haufftechnik.com/#sle](http://www.polywater-haufftechnik.com/#sle).
    - b. American Polywater Corporation; PHSD Mechanical Seals: [www.polywater-haufftechnik.com/#sle](http://www.polywater-haufftechnik.com/#sle).
    - c. American Polywater Corporation; PHSI 150 Varia Double Wall Inserts: [www.polywater-haufftechnik.com/#sle](http://www.polywater-haufftechnik.com/#sle).
    - d. American Polywater Corporation; PGKD Modular Seals: [www.polywater-haufftechnik.com/#sle](http://www.polywater-haufftechnik.com/#sle).
- J. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
  1. Products:
    - a. Alta Products, LLC; Sigrist Pipe Chase Housing, Curbs, and Exit Seals: [www.altaproductsllc.com/#sle](http://www.altaproductsllc.com/#sle).
    - b. Menzies Metal Products; Electrical Roof Stack and Cap: [www.menzies-metal.com/#sle](http://www.menzies-metal.com/#sle).
    - c. Menzies Metal Products; Electrical Retro Box: [www.menzies-metal.com/#sle](http://www.menzies-metal.com/#sle).
- K. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.



1. Products:
  - a. Quickflash Weatherproofing Products, Inc: [www.quickflashproducts.com/#sle](http://www.quickflashproducts.com/#sle).
- L. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
  1. Products:
    - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: [www.holdrite.com/#sle](http://www.holdrite.com/#sle).

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.
- E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- F. Liquidtight Flexible Nonmetallic Conduit (LFNC): Install in accordance with NECA 111.
- G. Conduit Routing:
  1. Unless dimensioned, conduit routing indicated is diagrammatic.
  2. When conduit destination is indicated without specific routing, determine exact routing required.
  3. Conceal conduits unless specifically indicated to be exposed.
  4. Conduits in the following areas may be exposed, unless otherwise indicated:
    - a. Electrical rooms.
    - b. Mechanical equipment rooms.
    - c. Within joists in areas with no ceiling.
  5. Unless otherwise approved, do not route exposed conduits:
    - a. Across floors.
    - b. Across roofs.
    - c. Across top of parapet walls.
    - d. Across building exterior surfaces.
  6. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
  7. Arrange conduit to maintain adequate headroom, clearances, and access.
  8. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
  9. Arrange conduit to provide no more than 150 feet between pull points.
  10. Route conduits above water and drain piping where possible.
  11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
  12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
  13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    - a. Heaters.

- b. Hot water piping.
  14. Group parallel conduits in same area on common rack.
- H. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 05 29.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
  3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
  4. Use conduit strap to support single surface-mounted conduit.
    - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
  5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
  6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
  7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
  8. Use of spring steel conduit clips for support of conduits is not permitted.
  9. Use of wire for support of conduits is not permitted.
  10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
  3. Use suitable adapters where required to transition from one type of conduit to another.
  4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
  5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
  6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
  7. Secure joints and connections to provide mechanical strength and electrical continuity.
- J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
  4. Conceal bends for conduit risers emerging above ground.
  5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
  7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.
- K. Underground Installation:
1. Provide trenching and backfilling; see Section 31 23 16.13.
  2. Minimum Cover, Unless Otherwise Indicated or Required:

- a. Underground, Exterior: 18 inches.
- b. Under Slab on Grade: 12 inches to bottom of slab.
3. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 05 53.
- L. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches on all sides unless otherwise indicated; see Section 03 30 00.
- M. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
  1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
  4. Where conduits are subject to earth movement by settlement or frost.
- N. Conduit Sealing:
  1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
    - a. Where conduits enter building from outside.
    - b. Where service conduits enter building from underground distribution system.
    - c. Where conduits enter building from underground.
    - d. Where conduits may transport moisture to contact live parts.
  2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
    - a. Where conduits pass from outdoors into conditioned interior spaces.
    - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- O. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- P. Provide grounding and bonding; see Section 26 05 26.
- Q. Identify conduits; see Section 26 05 53.

### **3.3 CLEANING**

- A. Clean interior of conduits to remove moisture and foreign matter.

### **3.4 PROTECTION**

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

**END OF SECTION**



## SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Floor boxes.
- E. Accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 08 31 00 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- E. Section 26 05 33.13 - Conduit for Electrical Systems:
  - 1. Conduit bodies and other fittings.
  - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- F. Section 26 05 33.23 - Surface Raceways for Electrical Systems:
- G. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 27 26 - Wiring Devices:
  - 1. Wall plates.
  - 2. Floor box service fittings.
  - 3. Additional requirements for locating boxes for wiring devices.
- I. Section 27 10 00 - Structured Cabling: Additional requirements for communications systems outlet boxes.

#### 1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- F. NFPA 70 - National Electrical Code.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- I. UL 508A - Industrial Control Panels.
- J. UL 514A - Metallic Outlet Boxes.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### **1.5 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures and floor boxes.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Keys for Lockable Enclosures: Two of each different key.

### **1.6 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.1 BOXES**

- A. General Requirements:
  1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
  1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  3. Use suitable concrete type boxes where flush-mounted in concrete.
  4. Use suitable masonry type boxes where flush-mounted in masonry walls.
  5. Use raised covers suitable for the type of wall construction and device configuration where required.
  6. Use shallow boxes where required by the type of wall construction.
  7. Do not use "through-wall" boxes designed for access from both sides of wall.

8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
  10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
  11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
  12. Minimum Box Size, Unless Otherwise Indicated:
    - a. Communications Systems Outlets: Comply with Section 27 10 00.
    - b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
  13. Wall Plates: Comply with Section 26 27 26.
  14. Manufacturers:
    - a. Cooper Crouse-Hinds, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
    - b. E-Lids LLC: [www.e-lids.com/#sle](http://www.e-lids.com/#sle).
    - c. Hubbell Incorporated; Bell Products: [www.hubbell-rtb.com/#sle](http://www.hubbell-rtb.com/#sle).
    - d. Hubbell Incorporated; RACO Products: [www.hubbell-rtb.com/#sle](http://www.hubbell-rtb.com/#sle).
    - e. Thomas & Betts Corporation: [www.tnb.com/#sle](http://www.tnb.com/#sle).
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  2. NEMA 250 Environment Type, Unless Otherwise Indicated:
  3. Junction and Pull Boxes Larger Than 100 cubic inches:
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
  4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
  5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
  6. Manufacturers:
    - a. Cooper B-Line, a division of Eaton Corporation: [www.cooperindustries.com/#sle](http://www.cooperindustries.com/#sle).
    - b. Hoffman, a brand of Pentair Technical Products: [www.hoffmanonline.com/#sle](http://www.hoffmanonline.com/#sle).
    - c. Hubbell Incorporated; Wiegmann Products: [www.hubbell-wiegmann.com/#sle](http://www.hubbell-wiegmann.com/#sle).
- D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
1. Manufacturers:
    - a. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
- E. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 27 26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
  2. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
  3. Manufacturer: Same as manufacturer of floor box service fittings.

## 2.2 ACCESSORIES

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.
  - 1. Manufacturers:
    - a. Quickflash Weatherproofing Products, Inc: [www.quickflashproducts.com/#sle](http://www.quickflashproducts.com/#sle).

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- F. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- G. Box Locations:
  - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
  - 2. Unless dimensioned, box locations indicated are approximate.
  - 3. Locate boxes as required for devices installed under other sections or by others.
    - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 27 26.
    - b. Communications Systems Outlets: Comply with Section 27 10 00.
  - 4. Locate boxes so that wall plates do not span different building finishes.
  - 5. Locate boxes so that wall plates do not cross masonry joints.
  - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
  - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
  - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
  - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
  - 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 05 33.13.



11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
  - a. Concealed above accessible suspended ceilings.
  - b. Within joists in areas with no ceiling.
  - c. Electrical rooms.
- H. Box Supports:
  1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
  2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
  1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
  2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
  3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- M. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- N. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- O. Close unused box openings.
- P. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- Q. Provide grounding and bonding in accordance with Section 26 05 26.
- R. Identify boxes in accordance with Section 26 05 53.

### **3.3 CLEANING**

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

### **3.4 PROTECTION**

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

**END OF SECTION**



## SECTION 26 05 33.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Surface raceway systems.
- B. Wireways.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 33.13 - Conduit for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices: Receptacles.

#### 1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NFPA 70 - National Electrical Code.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. UL 5 - Surface Metal Raceways and Fittings.
- E. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate rough-in locations of outlet boxes provided under Section 26 05 33.16 and conduit provided under Section 26 05 33.13 as required for installation of raceways provided under this section.
  - 3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install raceways until final surface finishes and painting are complete.
  - 2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
  - 1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.1 RACEWAY REQUIREMENTS**

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

### **2.2 SURFACE RACEWAY SYSTEMS**

- A. Manufacturers:
  - 1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 2. Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  - 3. MonoSystems, Inc: [www.monosystems.com/#sle](http://www.monosystems.com/#sle).
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Type 1 - Surface Raceway System:
  - 1. Raceway Type: Single channel, painted steel.
  - 2. Color: To be selected by Architect.
  - 3. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
  - 4. Products:
    - a. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).

### **2.3 WIREWAYS**

- A. Manufacturers:
  - 1. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  - 2. Enduro Composites: [www.endurocomposites.com/#sle](http://www.endurocomposites.com/#sle).
  - 3. nVent HOFFMAN: [www.nvent.com/#sle](http://www.nvent.com/#sle).
  - 4. Schneider Electric: [www.se.com/#sle](http://www.se.com/#sle).
- B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- C. Wireway Type, Unless Otherwise Indicated:
  - 1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
- D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.
- E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.
- F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install raceways plumb and level.



- D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- E. Secure and support raceways in accordance with Section 26 05 29 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Identify raceways in accordance with Section 26 05 53.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect raceways for damage and defects.
- B. Correct wiring deficiencies and replace damaged or defective raceways.

### **3.4 CLEANING**

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### **3.5 PROTECTION**

- A. Protect installed raceways from subsequent construction operations.

**END OF SECTION**



## SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

#### 1.2 RELATED REQUIREMENTS

- A. Section 09 91 13 - Exterior Painting.
- B. Section 09 91 23 - Interior Painting.
- C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 26 05 73 - Power System Studies: Arc flash hazard warning labels.
- E. Section 26 27 26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- F. Section 27 10 00 - Structured Cabling: Identification for communications cabling and devices.

#### 1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code.
- B. UL 969 - Marking and Labeling Systems.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
  - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
  - 2. Do not install identification products until final surface finishes and painting are complete.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

#### 1.6 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

### PART 2 PRODUCTS

#### 2.1 IDENTIFICATION REQUIREMENTS

- A. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Switchboards:

- 1) Identify ampere rating.
  - 2) Identify voltage and phase.
  - 3) Identify power source and circuit number. Include location when not within sight of equipment.
  - 4) Use identification nameplate to identify main overcurrent protective device.
  - 5) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
- b. Panelboards:
- 1) Identify ampere rating.
  - 2) Identify voltage and phase.
  - 3) Identify power source and circuit number. Include location when not within sight of equipment.
  - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
  - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
  - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
- c. Enclosed switches:
- 1) Identify power source and circuit number. Include location when not within sight of equipment.
- d. Electricity Meters:
- 1) Identify load(s) metered.
2. Service Equipment:
- a. Use identification nameplate to identify each service disconnecting means.
  - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
4. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
6. Use floor marking tape to identify required equipment working clearances for switchboards.
7. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
- a. Service equipment.
  - b. Industrial control panels.
  - c. Motor control centers.
  - d. Elevator control panels.
  - e. Industrial machinery.
8. Arc Flash Hazard Warning Labels: Comply with Section 26 05 73.
9. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".



10. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
  2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
  3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
    - a. Within boxes when more than one circuit is present.
  4. Use underground warning tape to identify direct buried cables.
- C. Identification for Boxes:
1. Use voltage markers or color coded boxes to identify systems other than normal power system.
    - a. Color-Coded Boxes: Field-painted in accordance with Section 09 91 23 and 09 91 13 per the same color code used for raceways.
      - 1) Fire Alarm System: Red.
  2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
    - a. For exposed boxes in public areas, use only identification labels.
- D. Identification for Devices:
1. Identification for Communications Devices: Comply with Section 27 10 00.
  2. Wiring Device and Wallplate Finishes: Comply with Section 26 27 26.
  3. Use identification label to identify fire alarm system devices.
    - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
  4. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
    - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.

## 2.2 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
1. Manufacturers:
    - a. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
    - b. Kolbi Pipe Marker Co; \_\_\_\_\_: [www.kolbipipemarkers.com/#sle](http://www.kolbipipemarkers.com/#sle).
    - c. Seton Identification Products; \_\_\_\_\_: [www.seton.com/#sle](http://www.seton.com/#sle).
  2. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.
    - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
  3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
  4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
  5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
  6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

- B. Identification Labels:
  - 1. Manufacturers:
    - a. Brady Corporation; \_\_\_\_\_: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
    - b. Brother International Corporation: [www.brother-usa.com/#sle](http://www.brother-usa.com/#sle).
    - c. Panduit Corp: [www.panduit.com/#sle](http://www.panduit.com/#sle).
  - 2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  - 3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
  - 1. Minimum Size: 1 inch by 2.5 inches.
  - 2. Legend:
    - a. Equipment designation or other approved description.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height:
    - a. Equipment Designation: 1/2 inch.
    - b. Other Information: 1/4 inch.
  - 5. Color:
    - a. Normal Power System: White text on black background.
    - b. Fire Alarm System: White text on red background.
- D. Format for Caution and Warning Messages:
  - 1. Minimum Size: 2 inches by 4 inches.
  - 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 1/2 inch.
  - 5. Color: Black text on yellow background unless otherwise indicated.
- E. Format for Receptacle Identification:
  - 1. Minimum Size: 3/8 inch by 1.5 inches.
  - 2. Legend: Power source and circuit number or other designation indicated.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 3/16 inch.
  - 5. Color: Black text on clear background.
- F. Format for Control Device Identification:
  - 1. Minimum Size: 3/8 inch by 1.5 inches.
  - 2. Legend: Load controlled or other designation indicated.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 3/16 inch.
  - 5. Color: Black text on clear background.
- G. Format for Fire Alarm Device Identification:
  - 1. Minimum Size: 3/8 inch by 1.5 inches.
  - 2. Legend: Designation indicated and device zone or address.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 3/16 inch.
  - 5. Color: Red text on white background.

## 2.3 WIRE AND CABLE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  - 2. HellermannTyton: [www.hellermannntyton.com/#sle](http://www.hellermannntyton.com/#sle).
  - 3. Panduit Corp: [www.panduit.com/#sle](http://www.panduit.com/#sle).

- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

## **2.4 UNDERGROUND WARNING TAPE**

- A. Manufacturers:
  - 1. Brady Corporation: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  - 2. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  - 3. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Legend: Type of service, continuously repeated over full length of tape.
- E. Color:

## **2.5 FLOOR MARKING TAPE**

- A. Manufacturers:
  - 1. Brady Corporation: [www.bradyid.com/#sle](http://www.bradyid.com/#sle).
  - 2. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  - 3. Insite Solutions, LLC: [www.stop-painting.com/#sle](http://www.stop-painting.com/#sle).
  - 4. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

## **2.6 WARNING SIGNS AND LABELS**

- A. Manufacturers:
  - 1. Brimar Industries, Inc: [www.brimar.com/#sle](http://www.brimar.com/#sle).
  - 2. Clarion Safety Systems, LLC: [www.clarionsafety.com/#sle](http://www.clarionsafety.com/#sle).
  - 3. Insite Solutions, LLC: [www.stop-painting.com/#sle](http://www.stop-painting.com/#sle).
  - 4. Seton Identification Products: [www.seton.com/#sle](http://www.seton.com/#sle).
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
  - 1. Materials:
    - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
    - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
  - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
  - 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
  - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
  - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

3. Minimum Size: 2 by 4 inches unless otherwise indicated.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

#### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  1. Surface-Mounted Equipment: Enclosure front.
  2. Flush-Mounted Equipment: Inside of equipment door.
  3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  4. Elevated Equipment: Legible from the floor or working platform.
  5. Branch Devices: Adjacent to device.
  6. Interior Components: Legible from the point of access.
  7. Boxes: Outside face of cover.
  8. Conductors and Cables: Legible from the point of access.
  9. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

#### **3.3 FIELD QUALITY CONTROL**

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

**END OF SECTION**

## SECTION 26 05 73 - POWER SYSTEM STUDIES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
  - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 53 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 21 00 - Low-Voltage Electrical Service Entrance.
- C. Section 26 24 13 - Switchboards.
- D. Section 26 24 16 - Panelboards.
- E. Section 26 28 16.16 - Enclosed Switches.

#### 1.3 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
- B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants.
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems.
- F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations.
- G. NEMA MG 1 - Motors and Generators.
- H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.
- I. NFPA 70 - National Electrical Code.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
  - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
  - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Submit study reports prior to or concurrent with product submittals.
  - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.

3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).
- C. Scheduling:
1. Arrange access to existing facility for data collection with Owner.
  2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Study reports, stamped or sealed and signed by study preparer.
- C. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
1. Include characteristic time-current trip curves for protective devices.
  2. Identify modifications made in accordance with studies that:
    - a. Can be made at no additional cost to Owner.
    - b. As submitted will involve a change to the contract sum.
- D. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- E. Site-specific arc flash hazard warning labels.
- F. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- G. Project Record Documents: Revise studies as required to reflect as-built conditions.
1. Include hard copies with operation and maintenance data submittals.
  2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

## 1.6 POWER SYSTEM STUDIES

- A. Scope of Studies:
1. Perform analysis of both new and directly affected existing portions of electrical distribution system as indicated on drawings.
  2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
  3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
- B. General Study Requirements:
1. Comply with NFPA 70.
  2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      - 1) Obtain up-to-date information from Utility Company.
      - 2) Utility Company: As indicated on drawings.
    - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.

- c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
  - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
  - e. Protective Devices:
    - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
    - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
  - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
  - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
2. Existing Installations:
- a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
  - b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
- D. Short-Circuit Study:
- 1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
  - 2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
    - a. Maximum utility fault currents.
    - b. Maximum motor contribution.
    - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
  - 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
- 1. Comply with applicable portions of IEEE 242 and IEEE 399.
  - 2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
  - 3. Analyze protective devices and associated settings for suitable margins between time-current curves to provide adequate protection for equipment and conductors while achieving best possible coordination.
    - a. Where indicated on drawings or required by Code, including NFPA 70, analyze to achieve full selective coordination.
- F. Arc Flash and Shock Risk Assessment:
- 1. Comply with NFPA 70E.
  - 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
    - a. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
    - b. For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584 using single phase bolted fault current, yielding conservative results.

3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
  4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
    - a. Maximum and minimum utility fault currents.
    - b. Maximum and minimum motor contribution.
    - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- G. Study Reports:
1. General Requirements:
    - a. Identify date of study and study preparer.
    - b. Identify study methodology and software product(s) used.
    - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
    - d. Identify base used for per unit values.
    - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
    - f. Include conclusions and recommendations.
  2. Short-Circuit Study:
    - a. For each scenario, identify at each bus location:
      - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      - 2) Fault point X/R ratio.
      - 3) Associated equipment short circuit current ratings.
    - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
  3. Protective Device Coordination Study:
    - a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
    - b. For each graph include (where applicable):
      - 1) Partial single-line diagram identifying the portion of the system illustrated.
      - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
      - 3) Conductors: Damage curves.
      - 4) Transformers: Inrush points and damage curves.
      - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
      - 6) Motors: Full load current, starting curves, and damage curves.
      - 7) Capacitors: Full load current and damage curves.
    - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
      - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
      - 2) Include ground fault pickup and delay.
      - 3) Include fuse ratings.
      - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
    - d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
  4. Arc Flash and Shock Risk Assessment:
    - a. For the worst case for each scenario, identify at each bus location:
      - 1) Calculated incident energy and associated working distance.



- 2) Calculated arc flash boundary.
- 3) Bolted fault current.
- 4) Arcing fault current.
- 5) Clearing time.
- 6) Arc gap distance.
- b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
- c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

## 1.7 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
  1. Products:
    - a. EasyPower LLC: [www.easypower.com/#sle](http://www.easypower.com/#sle).
    - b. ETAP/Operation Technology, Inc: [www.etap.com/#sle](http://www.etap.com/#sle).
    - c. Power Analytics Corporation: [www.poweranalytics.com/#sle](http://www.poweranalytics.com/#sle).
    - d. SKM Systems Analysis, Inc: [www.skm.com/#sle](http://www.skm.com/#sle).

## PART 2 PRODUCTS

### 2.1 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
  1. Materials: Comply with Section 26 05 53.
  2. Minimum Size: 4 by 6 inches.
  3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
    - a. Include orange header that reads "WARNING" unless otherwise indicated.
    - b. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
    - c. Include the following information:
      - 1) Arc flash boundary.
      - 2) Available incident energy and corresponding working distance.
      - 3) Nominal system voltage.
      - 4) Limited approach boundary.
      - 5) Restricted approach boundary.
      - 6) Equipment identification.
      - 7) Study preparer, report reference, and date calculations were performed.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install arc flash warning labels in accordance with Section 26 05 53.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Adjust equipment and protective devices for compliance with studies and recommended settings.
- C. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.



### **3.3 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

**END OF SECTION**

## SECTION 26 05 83 - WIRING CONNECTIONS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 33.13 - Conduit for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 27 26 - Wiring Devices.
- E. Section 26 28 16.16 - Enclosed Switches.

#### 1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices.
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications.
- C. NFPA 70 - National Electrical Code.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
  - 2. Determine connection locations and requirements.
- B. Sequencing:
  - 1. Install rough-in of electrical connections before installation of equipment is required.
  - 2. Make electrical connections before required start-up of equipment.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Comply with NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 28 16.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.13.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 33.16.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

#### 3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.



- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

**END OF SECTION**

## SECTION 26 09 23 - LIGHTING CONTROL DEVICES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Occupancy sensors.
- B. In-wall time switches.
- C. Lighting contactors.
- D. Accessories.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems
- D. Section 26 05 33.16 - Boxes for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
- G. Section 26 51 00 - Interior Lighting.

#### 1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
- F. NFPA 70 - National Electrical Code.
- G. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting.
- H. UL 916 - Energy Management Equipment.
- I. UL 917 - Clock-Operated Switches.
- J. UL 924 - Emergency Lighting and Power Equipment.
- K. UL 1008 - Transfer Switch Equipment.
- L. UL 1472 - Solid-State Dimming Controls.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate placement of lighting control devices with millwork, furniture, equipment and other potential conflicts.
  - 2. Coordinate placement of wall switch occupancy sensors with installed door swings.
  - 3. Coordinate placement of occupancy sensors with millwork, furniture, equipment and other potential obstructions to motion detection coverage.
  - 4. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 51 00 and lighting fixture schedule.
  - 5. Notify Architect of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
  - 1. Do not install lighting control devices until final surface finishes and painting are complete.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
  - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Field quality control reports.
- D. Operation and Maintenance Data: Include detailed information on device programming and setup.
- E. Project Record Documents: Record actual installed locations and settings for lighting control devices.

## 1.6 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for occupancy sensors.

## PART 2 PRODUCTS

### 2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for purpose intended.
- B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

### 2.2 OCCUPANCY SENSORS

- A. Manufacturers:
  - 1. Acuity Brands, Inc: [www.acuitybrands.com/#sle](http://www.acuitybrands.com/#sle).
  - 2. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  - 3. Intermatic, Inc: [www.intermatic.com/#sle](http://www.intermatic.com/#sle).
  - 4. Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  - 5. Lutron Electronics Company, Inc: [www.lutron.com/#sle](http://www.lutron.com/#sle).
  - 6. RAB Lighting, Inc: [www.rablighting.com/#sle](http://www.rablighting.com/#sle).
  - 7. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.
- B. General Requirements:
  - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
  - 2. Sensor Technology:
    - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
    - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
    - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.
  - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
  - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during adjustable turn-off delay time interval.

5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
  6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
  7. Sensitivity: Field adjustable.
  8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
  9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
  10. Load Rating for Line Voltage Occupancy Sensors: As required to control load indicated on drawings.
- C. Wall Switch Occupancy Sensors:
1. General Requirements:
    - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    - b. Unless otherwise indicated or required to control load indicated on drawings, provide line voltage units with self-contained relay.
    - c. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    - d. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during delayed-off time interval.
    - e. Finish: Match finishes specified for wiring devices in Section 26 27 26, unless otherwise indicated.
    - f. Finish: Color to be selected.
- D. Ceiling Mounted Occupancy Sensors:
1. General Requirements:
    - a. Description: Low profile occupancy sensors designed for ceiling installation.
    - b. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
    - c. Finish: White unless otherwise indicated.
  2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within area of 450 square feet at mounting height of 9 feet, with field of view of 360 degrees.
    - b. Extended Range Sensors: Capable of detecting motion within area of 1,200 square feet at mounting height of 9 feet, with field of view of 360 degrees.
- E. Power Packs for Low-Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low-voltage class 2 transformer and relay compatible with specified low-voltage occupancy sensors for switching of line-voltage loads.
  2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.
  3. Input Supply Voltage: Dual rated for 120/277 V ac.
  4. Load Rating: As required to control load indicated on drawings.

## 2.3 ACCESSORIES

- A. Control and Timing Relays:
1. Comply with NEMA ICS 5.
  2. Provide number and type of relays indicated or required to perform necessary functions.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.3 INSTALLATION**

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes as required for installation of lighting control devices; see Section 26 05 33.16.
  - 1. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- C. Maintain separation of remote-control, signaling, and power-limited circuits.
  - 1. See manufacturer instructions and Section 26 05 19 for control wiring conductors, wiring methods, and identification requirements.
- D. Install lighting control devices in accordance with manufacturer's instructions.
- E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- F. Install lighting control devices plumb and level, and held securely in place.
- G. Where required and not furnished with lighting control device, provide wall plate; see Section 26 27 26.
- H. Provide required supports; see Section 26 05 29.
- I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- J. Occupancy Sensor Locations:
  - 1. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspect each lighting control device for damage and defects.



- B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- C. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

### **3.5 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

### **3.6 CLEANING**

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

### **3.7 CLOSEOUT ACTIVITIES**

- A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of installed lighting control devices.
  - 4. Location: At project site.

**END OF SECTION**



## SECTION 26 21 00 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Electrical service requirements.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 33.13 - Conduit for Electrical Systems.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 24 13 - Switchboards: Service entrance equipment.
  - 1. Includes non-utility electrical metering.
- G. Section 26 43 00 - Surge Protective Devices: Service entrance surge protective devices.

#### 1.3 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

#### 1.4 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NEC(R)).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NFPA 70 - National Electrical Code.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
  - 1. Verify the following with Utility Company representative:
    - a. Utility Company requirements, including division of responsibility.
    - b. Exact location and details of utility point of connection.
    - c. Utility easement requirements.
    - d. Utility Company charges associated with providing service.
  - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
  - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
  - 1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
  - 2. Arrange for inspections necessary to obtain Utility Company approval of installation.

## 1.6 QUALITY ASSURANCE

- A. Comply with the following:
  - 1. IEEE C2 (National Electrical Safety Code).
  - 2. NFPA 70 (National Electrical Code).
  - 3. The requirements of the Utility Company.

## PART 2 PRODUCTS

### 2.1 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Division of Responsibility:
  - 1. Pad-Mounted Utility Transformers:
    - a. Transformer Vaults and Pads: Furnished and installed by Contractor per Utility Company requirements.
    - b. Transformers: Furnished and installed by Utility Company.
    - c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
    - d. Primary:
      - 1) Trenching and Backfilling: Provided by Contractor.
      - 2) Conduits: Furnished and installed by Contractor.
      - 3) Conductors: Furnished and installed by Utility Company.
    - e. Secondary:
      - 1) Trenching and Backfilling: Provided by Contractor.
      - 2) Conduits: Furnished and installed by Contractor.
      - 3) Conductors: Furnished and installed by Contractor (Service Point at transformer).
  - 2. Terminations at Service Point: Provided by Utility Company.
  - 3. Metering Provisions:
    - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
- D. Products Furnished by Contractor: Comply with Utility Company requirements.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment components in accordance with Section 26 05 29.
- E. Provide grounding and bonding for service entrance equipment in accordance with Section 26 05 26.



- F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 05 53.

**END OF SECTION**



## SECTION 26 24 13 - SWITCHBOARDS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

#### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 26 21 00 - Low-Voltage Electrical Service Entrance.
- G. Section 26 43 00 - Surge Protective Devices.

#### 1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NEMA PB 2 - Deadfront Distribution Switchboards.
- G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less.
- H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.
- I. NFPA 70 - National Electrical Code.
- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- K. UL 869A - Reference Standard for Service Equipment.
- L. UL 891 - Switchboards.
- M. UL 1053 - Ground-Fault Sensing and Relaying Equipment.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Service Entrance Switchboards:
1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
  2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
  3. Obtain Utility Company approval of switchboard prior to fabrication.
  4. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements with Utility Company representative.
  5. Arrange for inspections necessary to obtain Utility Company approval of installation.

## 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
  2. Include wiring diagrams showing all factory and field connections.
  3. Include documentation demonstrating selective coordination upon request.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Field Quality Control Test Reports.
- G. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Enclosure Keys: Two of each different key.

## 1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.



- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

## 1.8 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Switchboards:
  1. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
  2. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
  3. Schneider Electric: [www.se.com/#sle](http://www.se.com/#sle).
  4. Siemens Industry, Inc: [www.new.siemens.com/#sle](http://www.new.siemens.com/#sle).

### 2.2 SWITCHBOARDS

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Front-Connected Switchboards:
  1. Main Device(s): Individually-mounted.
  2. Feeder Devices: Individually-mounted.
  3. Arrangement: Front accessible only (not rear accessible), rear aligned.
  4. Gutter Access: Bolted covers.
- E. Service Entrance Switchboards:
  1. Listed and labeled as suitable for use as service equipment according to UL 869A.
  2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
  3. Comply with Utility Company requirements for electrical service.
- F. Service Conditions:
  1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
    - a. Altitude: Less than 6,600 feet.
    - b. Ambient Temperature:
      - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
  2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- G. Short Circuit Current Rating:
  1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
  2. Minimum Rating: 65,000 rms symmetrical amperes.
- H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- I. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- J. Bussing: Sized in accordance with UL 891 temperature rise requirements.

1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
  2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  4. Phase and Neutral Bus Material: Copper.
  5. Ground Bus Material: Copper.
- K. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
    - a. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
    - b. Main and Neutral Lug Type: Mechanical.
  2. Load Conductor Terminations:
    - a. Lug Material: Copper, suitable for terminating copper conductors only.
    - b. Lug Type:
      - 1) Provide mechanical lugs unless otherwise indicated.
- L. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
  2. Finish: Manufacturer's standard unless otherwise indicated.
- M. Future Provisions:
1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- N. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list switchboards as a complete assembly including surge protective device.
- O. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
- P. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- Q. Owner Metering:
1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
  2. Measured Parameters:
    - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
    - b. Current (Amps): For each phase and neutral.
    - c. Frequency (Hz).
    - d. Real power (kW): For each phase, 3-phase total.
    - e. Reactive power (kVAR): For each phase, 3-phase total.
    - f. Apparent power (kVA): For each phase, 3-phase total.
    - g. Power factor.
    - h. Real energy (kWh).
    - i. Current demand.
    - j. Power demand: Real, reactive, and apparent.
  3. Meter Accuracy: Plus/minus 1.0 percent.
  4. Features:

- a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
- b. Adjustable demand interval.
- c. Remote monitoring capability via PC.

R. Instrument Transformers:

1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

## 2.3 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:

1. Interrupting Capacity:
  - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
  - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Molded Case Circuit Breakers:
  - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
    - 1) Provide electronic trip circuit breakers where indicated.
  - b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
    - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 200 amperes and larger.
  - c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
    - 1) Provide the following field-adjustable trip response settings:
      - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
      - (b) Long time delay.
      - (c) Short time pickup and delay.
      - (d) Instantaneous pickup.
      - (e) Ground fault pickup and delay where ground fault protection is indicated.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
1. Dielectric tests.
  2. Mechanical operation tests.
  3. Grounding of instrument transformer cases test.
  4. Electrical operation and control wiring tests, including polarity and sequence tests.
  5. Ground-fault sensing equipment test.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.

- D. Verify that conditions are satisfactory for installation prior to starting work.
- E. For existing equipment that is being reconnected to the new switchboard, confirm the existing fuse size serving the equipment in the demolished switchboard. The new circuit breaker sizes shall match the existing fuse sizes. Notify engineer for any discrepancies and record correct sizes on as-built drawings.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install switchboards plumb and level.
- G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
- H. Provide grounding and bonding in accordance with Section 26 05 26.
- I. Install all field-installed devices, components, and accessories.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 05 73.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Provide filler plates to cover unused spaces in switchboards.
- N. Identify switchboards in accordance with Section 26 05 53.

### 3.3 FIELD QUALITY CONTROL

- A. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
- B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- C. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- D. Inspect and test in accordance with NETA ATS, except Section 4.
- E. Perform inspections and tests listed in NETA ATS, Section 7.1.
- F. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 200 amperes. Tests listed as optional are not required.
- G. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
  - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- H. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

- I. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- J. Correct deficiencies and replace damaged or defective switchboards or associated components.
- K. Submit detailed reports indicating inspection and testing results and corrective actions taken.

### **3.4 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

### **3.5 CLEANING**

- A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

### **3.6 CLOSEOUT ACTIVITIES**

- A. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Instructor: Manufacturer's authorized representative.
  - 3. Location: At project site.

### **3.7 PROTECTION**

- A. Protect installed switchboards from subsequent construction operations.

**END OF SECTION**



## SECTION 26 24 16 - PANELBOARDS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

#### 1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
- F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- G. NEMA PB 1 - Panelboards.
- H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less.
- I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.
- J. NFPA 70 - National Electrical Code.
- K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- M. UL 67 - Panelboards.
- N. UL 98 - Enclosed and Dead-Front Switches.
- O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- P. UL 869A - Reference Standard for Service Equipment.
- Q. UL 943 - Ground-Fault Circuit-Interrupters.
- R. UL 1053 - Ground-Fault Sensing and Relaying Equipment.
- S. UL 1699 - Arc-Fault Circuit-Interrupters.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### **1.5 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
  1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
  2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 60 00 - Product Requirements, for additional provisions.
  2. Panelboard Keys: Two of each different key.

### **1.6 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

### **1.8 FIELD CONDITIONS**

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
  1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
- B. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric: [www.se.com/#sle](http://www.se.com/#sle).
- D. Siemens Industry, Inc: [www.new.siemens.com/#sle](http://www.new.siemens.com/#sle).



## 2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature:
    - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
  - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
  - 2. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
  - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
  - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
  - 2. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
    - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
    - c. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
  - 3. Fronts:
    - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
    - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
    - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
  - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Load centers are not acceptable.
- K. Provide the following features and accessories where indicated or where required to complete installation:
  - 1. Feed-through lugs.
  - 2. Sub-feed lugs.

## 2.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
  - 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
  - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
  - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
  - 2. Phase and Neutral Bus Material: Copper.
  - 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
  - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
  - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
  - 3. Provide clear plastic circuit directory holder mounted on inside of door.

## 2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
  - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
  - 2. Interrupting Capacity:
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      - 1) 22,000 rms symmetrical amperes at 240 VAC or 208 VAC.
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  - 3. Conductor Terminations:
    - a. Provide mechanical lugs unless otherwise indicated.
    - b. Lug Material: Copper, suitable for terminating copper conductors only.
  - 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
  - 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
  - 6. Do not use tandem circuit breakers.
  - 7. Do not use handle ties in lieu of multi-pole circuit breakers.

## 2.5 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 26 05 26.
- K. Install all field-installed branch devices, components, and accessories.
- L. Provide filler plates to cover unused spaces in panelboards.
- M. Identify panelboards in accordance with Section 26 05 53.

### **3.3 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 200 amperes. Tests listed as optional are not required.
- C. Correct deficiencies and replace damaged or defective panelboards or associated components.

### **3.4 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.

### **3.5 CLEANING**

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION**



## SECTION 26 27 26 - WIRING DEVICES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates and covers.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 33.16 - Boxes for Electrical Systems.
- D. Section 26 05 33.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 05 83 - Wiring Connections: Cords and plugs for equipment.
- G. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

#### 1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NEMA WD 1 - General Color Requirements for Wiring Devices.
- G. NEMA WD 6 - Wiring Devices - Dimensional Specifications.
- H. NFPA 70 - National Electrical Code.
- I. UL 20 - General-Use Snap Switches.
- J. UL 498 - Attachment Plugs and Receptacles.
- K. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.
- L. UL 943 - Ground-Fault Circuit-Interrupters.
- M. UL 1310 - Class 2 Power Units.
- N. UL 1449 - Standard for Surge Protective Devices.
- O. UL 1472 - Solid-State Dimming Controls.
- P. UL 1917 - Solid-State Fan Speed Controls.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
  - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Operation and Maintenance Data:
  1. GFCI Receptacles: Include information on status indicators.
- D. Project Record Documents: Record actual installed locations of wiring devices.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. See Section 01 60 00 - Product Requirements, for additional provisions.
  2. Extra Keys for Locking Switches: Two of each type.
  3. Extra Wall Plates: One of each style, size, and finish.

### 1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

### 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

## PART 2 PRODUCTS

### 2.1 WIRING DEVICES - GENERAL REQUIREMENTS

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.
- B. Wiring Device Applications:
  1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.
  2. Provide GFCI protection for:
    - a. Receptacles installed within 6 feet of sinks.
    - b. Receptacles serving electric drinking fountains.
  3. Single Receptacles Installed on Individual Branch Circuits: Provide receptacle ampere rating equal to branch circuit rating.
- C. Wiring Device Finishes:
  1. Provide wiring device finishes as described below, unless otherwise indicated.
  2. Wiring Devices, Unless Otherwise Indicated: White with stainless steel wall plate.
  3. Wiring Devices Installed in Unfinished Spaces: White with galvanized steel wall plate.
  4. Wiring Devices Installed in Wet or Damp Locations: White with weatherproof cover.

### 2.2 WALL SWITCHES

- A. Manufacturers:
  1. Hubbell Incorporated: [www.hubbell.com/#sle](http://www.hubbell.com/#sle).
  2. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
  3. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- D. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

## 2.3 RECEPTACLES

- A. Manufacturers:
  1. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
  2. Lutron Electronics Company, Inc: [www.lutron.com/#sle](http://www.lutron.com/#sle).
  3. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
  4. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
  1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
  2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
  1. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
  1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
  2. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
  3. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

## 2.4 WALL PLATES AND COVERS

- A. Manufacturers:
  1. Hubbell Incorporated: [www.hubbell-wiring.com/#sle](http://www.hubbell-wiring.com/#sle).
  2. Intermatic, Inc: [www.intermatic.com/#sle](http://www.intermatic.com/#sle).
  3. Leviton Manufacturing Company, Inc: [www.leviton.com/#sle](http://www.leviton.com/#sle).
  4. Lutron Electronics Company, Inc: [www.lutron.com/#sle](http://www.lutron.com/#sle).
  5. Pass & Seymour, a brand of Legrand North America, Inc: [www.legrand.us/#sle](http://www.legrand.us/#sle).
- B. Wall Plates: Comply with UL 514D.
  1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
  2. Size: Standard.
  3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

- E. Weatherproof Receptacle Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.2 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

#### **3.3 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of wiring devices provided under this section.
  - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
  - 2. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
  - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
  - 4. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Do not share neutral conductor on branch circuits utilizing wall dimmers.



- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- O. Identify wiring devices in accordance with Section 26 05 53.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

### **3.5 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.

### **3.6 CLEANING**

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**END OF SECTION**



## SECTION 26 28 16.16 - ENCLOSED SWITCHES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Enclosed safety switches.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 73 - Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.

#### 1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.
- E. NFPA 70 - National Electrical Code.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- H. UL 98 - Enclosed and Dead-Front Switches.
- I. UL 869A - Reference Standard for Service Equipment.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.5 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
  - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
- D. Project Record Documents: Record actual locations of enclosed switches.

- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

## 1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

## 1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
- B. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
- C. Schneider Electric: [www.se.com/#sle](http://www.se.com/#sle).
- D. Siemens Industry, Inc: [www.new.siemens.com/#sle](http://www.new.siemens.com/#sle).
- E. Source Limitations: Provide enclosed switches and associated components produced by same manufacturer as other electrical distribution equipment used for project and obtained from single supplier.

### 2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
  - 1. Altitude: Less than 6,600 feet.
  - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
  - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
  - 2. Minimum Ratings:
    - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
    - b. General Duty Single Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
    - c. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
    - d. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- G. Provide with switch blade contact position that is visible when the cover is open.

- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- M. Heavy Duty Switches:
  - 1. Comply with NEMA KS 1.
  - 2. Conductor Terminations:
    - a. Provide mechanical lugs unless otherwise indicated.
    - b. Lug Material: Copper, suitable for terminating copper conductors only.
  - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
    - a. Provide means for locking handle in the ON position where indicated.
- N. Provide the following features and accessories where indicated or where required to complete installation:
  - 1. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.

#### **3.3 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.



- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

### **3.4 ADJUSTING**

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

### **3.5 CLEANING**

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION**

## SECTION 26 43 00 - SURGE PROTECTIVE DEVICES

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 24 13 - Switchboards.

#### 1.3 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

#### 1.4 REFERENCE STANDARDS

- A. MIL-STD-220 - Method of Insertion Loss Measurement.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.
- E. NFPA 70 - National Electrical Code.
- F. UL 1283 - Standard for Electromagnetic Interference Filters.
- G. UL 1449 - Standard for Surge Protective Devices.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

#### 1.6 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
- C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
- D. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- E. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- F. Project Record Documents: Record actual connections and locations of surge protective devices.

#### 1.7 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

#### 1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

## 1.9 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

## 1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Factory-installed, Internally Mounted Surge Protective Devices:
  - 1. Same as manufacturer of equipment containing surge protective device, to provide complete listed assembly including SPD.
- B. Source Limitations: Provide surge protective devices produced by single manufacturer and obtained from single supplier.

### 2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.
- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
  - 1. Wye Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
  - 1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 1. Indoor clean, dry locations: Type 1.
- H. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
  - 1. Switchboards: See Section 26 24 13.

### 2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Surge Protective Device - Basis of Design: Surge Suppression, LLC (SSI); Advantage Series; Model SSLB (100 kA/phase, Type 2, I-n = 20 kA); [www.surgesuppression.com/#sle](http://www.surgesuppression.com/#sle).
  - 1. Voltage: As indicated on drawings.
  - 2. Features: Discrete "all-mode" protection (10 modes for 3-phase wye circuits); component-level thermal fusing; internal circuit board-mounted overcurrent fusing; 200 kAIC SCCR; 25 year warranty.
  - 3. Include the following options:
    - a. AC10 - Basic internal audible alarm with dry relay contacts.
    - b. C - Form C dry relay contacts.
    - c. S6 - Surge counter with reset button.
    - d. (Only one of the following may be selected)



- e. D1 - NEMA 1, 2, 3, 3S, 4X, and 12 composite enclosure with integral non-fused disconnect switch, with external handle
- f. OTHER OPTIONS----->

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 26 05 26, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- E. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.2 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- C. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- D. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
- E. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- F. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 05 26 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- G. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

#### **3.3 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.

#### **3.4 CLEANING**

- A. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION**



## SECTION 26 51 00 - INTERIOR LIGHTING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Exit signs.
- C. Ballasts and drivers.

#### 1.2 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 33.16 - Boxes for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 09 23 - Lighting Control Devices.
- E. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.

#### 1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices.
- B. ANSI C82.4 - American National Standard for Lamp Ballasts - Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
- C. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- F. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code).
- G. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- H. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.
- I. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.
- J. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.
- K. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- L. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.
- M. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems.
- N. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
- O. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.
- P. NFPA 70 - National Electrical Code.
- Q. NFPA 101 - Life Safety Code.
- R. UL 924 - Emergency Lighting and Power Equipment.
- S. UL 1598 - Luminaires.

- T. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

#### **1.5 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution upon request.

- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

- a. Include estimated useful life, calculated based on IES LM-80 test data.

- D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.

#### **1.6 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.

#### **1.7 DELIVERY, STORAGE, AND PROTECTION**

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

#### **1.8 FIELD CONDITIONS**

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

#### **1.9 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

- C. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

## **PART 2 PRODUCTS**

### **2.1 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings.

### **2.2 LUMINAIRES**

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
  - 1. Ceiling Compatibility: Comply with NEMA LE 4.
- H. LED Luminaires:
  - 1. Components: UL 8750 recognized or listed as applicable.
  - 2. Tested in accordance with IES LM-79 and IES LM-80.
  - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

### **2.3 EXIT SIGNS**

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
  - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
  - 2. Directional Arrows: As indicated or as required for installed location.
- B. Accessories:
  - 1. Provide compatible accessory wire guards where indicated.

### **2.4 BALLASTS AND DRIVERS**

- A. Ballasts/Drivers - General Requirements:
  - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
  - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
  - 3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

### **2.5 ACCESSORIES**

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

### **3.2 PREPARATION**

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### **3.3 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 05 29.
- F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- G. Suspended Ceiling Mounted Luminaires:
  - 1. Do not use ceiling tiles to bear weight of luminaires.
  - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
  - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
  - 4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
  - 5. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Recessed Luminaires:
  - 1. Install trims tight to mounting surface with no visible light leakage.
- I. Suspended Luminaires:
  - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
  - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
  - 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
  - 4. Unless otherwise indicated, support pendants from swivel hangers.
- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Install accessories furnished with each luminaire.
- L. Bond products and metal accessories to branch circuit equipment grounding conductor.
- M. Exit Signs:

- N. Identify luminaires connected to emergency power system in accordance with Section 26 05 53.
- O. Install lamps in each luminaire.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

### **3.5 ADJUSTING**

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

### **3.6 CLEANING**

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

### **3.7 CLOSEOUT ACTIVITIES**

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

### **3.8 PROTECTION**

- A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION**





## SECTION 27 05 05 - SELECTIVE DEMOLITION FOR COMMUNICATIONS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Communications demolition.

#### 1.2 RELATED DOCUMENTS

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

#### 1.3 COORDINATION

- A. Coordinate all work with job site superintendent and all applicable trades.
- B. Coordinate communications utility service outages with Utility Company and Owner.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT AND MATERIALS

- A. Equipment and materials for patching and extending work: As specified in individual Sections.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on casual field observation.
- D. Report discrepancies to Architect before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

#### 3.2 PREPARATION

- A. Disconnect communications systems in walls, floors, and ceilings scheduled for removal.
- B. Maintain access to existing communications installations that remain active. Modify installation or provide access panel as appropriate.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Network Structured Cabling System
  - 1. Maintain existing system in service until new system is accepted.
  - 2. Disable system only to make switchovers and connections. Obtain permission from Owner and Communications Utility Company at least 24 hours before partially or completely disabling system. Minimize outage duration.
  - 3. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing Paging/Intercom/Program System
  - 1. Maintain existing system in service until new system is accepted.
  - 2. Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.
  - 3. Make temporary connections to maintain service in areas adjacent to work area.

#### 3.3 DEMOLITION AND EXTENSION OF EXISTING COMMUNICATIONS WORK

- A. Demolish and extend existing communications work as indicated on Drawings.
- B. Remove, relocate, and extend existing installations to accommodate new construction.



- C. Remove abandoned wires and cables to source of supply. This includes but is not limited to network cables (telephone/voice, data, etc.), audio-video systems cables, paging/intercom cables, video distribution (coaxial, UTP, etc.) cable, clock system cables, and control wiring unless noted otherwise.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces to match existing finishes.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlet boxes if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes and flush junction boxes that are not removed.
- F. Disconnect abandoned junction boxes, enclosures, racks, and cable supports. Remove abandoned equipment if conduit or cable servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes that are not removed.
- G. Disconnect and remove related electrical devices and equipment serving communications equipment that has been removed.
- H. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

### **3.4 INSTALLATION**

- A. Install relocated materials and equipment as indicated in applicable specification Sections and on the Drawings.

### **3.5 REPAIR**

- A. Repair existing equipment and materials that remain within the project work area(s) or are intended to be reused.
- B. Repair adjacent construction and finishes damaged during demolition and extension work to match existing.

### **3.6 CLEANING**

- A. Clean existing equipment and materials that remain within the project work area(s) or are intended to be reused.

**END OF SECTION**

## **SECTION 27 05 29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 27 05 33.13 - Conduit for Communications Systems: Additional support and attachment requirements for conduits.

#### **1.3 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- D. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition.
- E. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition.
- F. MFMA-4 - Metal Framing Standards Publication.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- H. NFPA 70 - National Electrical Code.
- I. TIA-569 - Telecommunications Pathways and Spaces.
- J. UL 5B - Strut-Type Channel Raceways and Fittings.
- K. UL 2024 - Standard for Cable Routing Assemblies and Communications Raceways.
- L. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
  - 2. Coordinate work to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
  - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
  - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03 30 00.

#### **1.5 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
  - 1. Comply with the following. Where requirements differ, comply with most stringent.
    - a. TIA-569.
    - b. NFPA 70.
    - c. Requirements of authorities having jurisdiction.
  - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
  - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
  - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit Supports: Straps and clamps suitable for conduit to be supported.
  - 1. Manufacturers:
    - a. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
  - 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  - 3. Conduit Clamps: Bolted type unless otherwise indicated.
  - 4. Products:
    - a. Gripple, Inc; Universal Bracket: [www.gripple.com/#sle](http://www.gripple.com/#sle).
    - b. Gripple, Inc; Universal Clamp (Threaded): [www.gripple.com/#sle](http://www.gripple.com/#sle).
- C. Noncontinuous Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.
  - 1. Manufacturers:
    - a. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. Panduit: [www.panduit.com/#sle](http://www.panduit.com/#sle).
  - 2. Applications:
    - a. Do not exceed 5 feet between cable supports.
    - b. Maximum Number of Cables per Cable Support:
      - 1) J-Hooks: 50, regardless of capacity.
      - 2) Bridle Rings: 40 percent of fill capacity.
  - 3. Cable Supports Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.

4. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
  - a. Material: Use galvanized steel, factory-painted steel, or stainless steel.
  - b. Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.
  - c. Provide multitiered J-hooks where required to support multiple cabling systems.
5. Bridle Rings: Noncontinuous circular cabling support.
  - a. Material: Use galvanized steel, painted steel, or stainless steel.
  - b. Provide integral saddle with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported where indicated.
6. Products:
  - a. Gripple, Inc; Fast Trak J-Hook: [www.gripple.com/#sle](http://www.gripple.com/#sle).
- D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
  1. Manufacturers:
    - a. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
- E. Metal Channel/Strut Framing Systems:
  1. Manufacturers:
    - a. ABB: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Atkore International Inc; Unistrut: [www.unistrut.us/#sle](http://www.unistrut.us/#sle).
    - c. Eaton Corporation: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - d. Source Limitations: Furnish channel/strut and associated fittings, accessories, and hardware produced by single manufacturer.
  2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
  3. Comply with MFMA-4.
  4. Channel/Strut Used as Raceway, Where Indicated: Listed and labeled as complying with UL 5B.
  5. Channel Material:
    - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
  6. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
  7. Minimum Channel Dimensions: 1-5/8 inch wide by 13/16 inch high.
- F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
  1. Minimum Size, Unless Otherwise Indicated or Required:
    - a. Equipment Supports: 1/2-inch diameter.
    - b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
    - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
    - d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
    - e. Outlet Boxes: 1/4-inch diameter.
- G. Anchors and Fasteners:
  1. Manufacturers - Mechanical Anchors:
    - a. Dewalt: [anchors.dewalt.com/#sle](http://anchors.dewalt.com/#sle).
    - b. Hilti, Inc: [www.hilti.com/#sle](http://www.hilti.com/#sle).
    - c. ITW Red Head, a division of Illinois Tool Works, Inc: [www.itwredhead.com/#sle](http://www.itwredhead.com/#sle).
    - d. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).
  2. Manufacturers - Powder-Actuated Fastening Systems:
    - a. Dewalt: [anchors.dewalt.com/#sle](http://anchors.dewalt.com/#sle).
    - b. Hilti, Inc: [www.hilti.com/#sle](http://www.hilti.com/#sle).
    - c. ITW Ramset, a division of Illinois Tool Works, Inc: [www.ramset.com/#sle](http://www.ramset.com/#sle).
    - d. Simpson Strong-Tie Company Inc: [www.strongtie.com/#sle](http://www.strongtie.com/#sle).

3. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
6. Hollow Masonry: Use toggle bolts.
7. Hollow Stud Walls: Use toggle bolts.
8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
9. Sheet Metal: Use sheet metal screws.
10. Wood: Use wood screws.
11. Plastic and lead anchors are not permitted.
12. Powder-actuated fasteners are permitted only as follows:
  - a. Where approved by Architect.
13. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
  - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
  - b. Comply with MFMA-4.
  - c. Channel Material: Use galvanized steel.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Equipment Support and Attachment:
  1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
  2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners in accordance with manufacturer's recommended torque settings.
- K. Remove temporary supports.



### **3.3 FIELD QUALITY CONTROL**

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**





## SECTION 27 05 33.13 - CONDUIT FOR COMMUNICATIONS SYSTEMS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Flexible metal conduit (FMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Galvanized steel electrical metallic tubing (EMT).
- E. Rigid polyvinyl chloride (PVC) conduit.
- F. Liquidtight flexible nonmetallic conduit (LFNC).
- G. Inside-plant flexible nonmetallic communications raceway/innerduct.

#### 1.2 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 33.13 - Conduit for Electrical Systems.
- C. Section 27 05 29 - Hangers and Supports for Communications Systems.

#### 1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit.
- D. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition.
- E. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition.
- F. BICSI TDMM - Telecommunications Distribution Methods Manual, 14th Edition.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- H. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).
- I. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC).
- J. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- K. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.
- L. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
- M. NFPA 70 - National Electrical Code.
- N. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises.
- O. TIA-569 - Telecommunications Pathways and Spaces.
- P. UL 1 - Flexible Metal Conduit.
- Q. UL 6 - Electrical Rigid Metal Conduit-Steel.
- R. UL 360 - Liquid-Tight Flexible Metal Conduit.
- S. UL 514A - Metallic Outlet Boxes.
- T. UL 514B - Conduit, Tubing, and Cable Fittings.
- U. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- V. UL 797 - Electrical Metallic Tubing-Steel.
- W. UL 1242 - Electrical Intermediate Metal Conduit-Steel.

- X. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit.
- Y. UL 2024 - Standard for Cable Routing Assemblies and Communications Raceways.
- Z. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with actual type and quantity of cables to be installed.
  - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
  - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
  - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not begin installation of communications cables until installation of conduit between termination points is complete.

#### **1.5 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.1 CONDUIT APPLICATIONS**

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, TIA-569, BICSI ITSIMM, BICSI TDMM, manufacturers' instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- D. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
- E. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), or inside-plant flexible nonmetallic communications raceway/innerduct.
- F. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
- G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
- H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC) or galvanized steel electrical metallic tubing (EMT).
  - 1. Locations subject to physical damage include, but are not limited to:

- I. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC).
  - 1. Locations subject to severe physical damage include, but are not limited to:
- J. Flexible Connections to Vibrating Equipment:
  - 1. Dry Locations: Use flexible metal conduit.
  - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
  - 3. Maximum Length: 6 feet unless otherwise indicated.

## 2.2 CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70 and TIA-569.
- B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
- C. Provide conduit, fittings, supports, and accessories required for complete communications pathway.
- D. Provide products listed, classified, and labeled as suitable for purpose intended.
- E. Minimum Conduit Size, Unless Otherwise Indicated:
  - 1. Continuous Conduit Homerun Serving One Communications Outlet Box: 1-inch trade size.
  - 2. Continuous Conduit Homerun Serving Two Communications Outlet Boxes: 1-inch trade size.
  - 3. Continuous Conduit Homerun Serving Three Communications Outlet Boxes: 1-1/4-inch trade size.
- F. Where conduit size is not indicated, size to comply with NFPA 70, TIA-569, and BICSI TDMM, but not less than applicable minimum size requirements specified. Where specified standards differ, comply with most stringent.

## 2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
  - 1. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.us/#sle](http://www.alliedeg.us/#sle).
  - 2. Nucor Tubular Products: [www.nucortubular.com/#sle](http://www.nucortubular.com/#sle).
  - 3. Western Tube, a division of Zekelman Industries: [www.westerntube.com/#sle](http://www.westerntube.com/#sle).
  - 4. Wheatland Tube, a division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
  - 1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.us/#sle](http://www.alliedeg.us/#sle).
    - c. Bridgeport Fittings Inc: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
    - d. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
  - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
  - 3. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.
  - 4. Connectors and Couplings: Use threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
  - 5. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
    - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

## 2.4 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
  - 1. AFC Cable Systems, a division of Atkore International: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  - 2. Electri-Flex Company: [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  - 3. International Metal Hose: [www.metalhose.com/#sle](http://www.metalhose.com/#sle).
- B. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- C. Fittings:
  - 1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Bridgeport Fittings, LLC: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
    - c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
  - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.
  - 4. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

## 2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
  - 1. AFC Cable Systems, a division of Atkore International: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  - 2. Electri-Flex Company: [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  - 3. International Metal Hose: [www.metalhose.com/#sle](http://www.metalhose.com/#sle).
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
  - 1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Bridgeport Fittings, LLC: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
    - c. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
  - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 3. Material: Use steel or malleable iron.
    - a. Do not use die cast zinc fittings.
  - 4. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
    - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

## 2.6 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
  - 1. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.us/#sle](http://www.alliedeg.us/#sle).
  - 2. Nucor Tubular Products: [www.nucortubular.com/#sle](http://www.nucortubular.com/#sle).
  - 3. Western Tube, a division of Zekelman Industries: [www.westerntube.com/#sle](http://www.westerntube.com/#sle).
  - 4. Wheatland Tube, a division of Zekelman Industries: [www.wheatland.com/#sle](http://www.wheatland.com/#sle).
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
  - 1. Manufacturers:
    - a. ABB; T&B: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
    - b. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.us/#sle](http://www.alliedeg.us/#sle).

- c. Bridgeport Fittings, LLC: [www.bptfittings.com/#sle](http://www.bptfittings.com/#sle).
- d. Emerson Electric Co; O-Z/Gedney: [www.emerson.com/#sle](http://www.emerson.com/#sle).
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
  - a. Do not use die cast zinc fittings.
4. Connectors and Couplings: Use compression/gland or set-screw type.
  - a. Do not use indenter type connectors and couplings.
5. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.
6. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
  - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

## 2.7 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
  1. ABB; Carlon: [www.electrification.us.abb.com/#sle](http://www.electrification.us.abb.com/#sle).
  2. Allied Tube & Conduit, a division of Atkore International: [www.alliedeg.us/#sle](http://www.alliedeg.us/#sle).
  3. Cantex Inc: [www.cantexinc.com/#sle](http://www.cantexinc.com/#sle).
  4. Heritage Plastics, a division of Atkore International: [www.heritageplastics.com/#sle](http://www.heritageplastics.com/#sle).
  5. JM Eagle: [www.jmeagle.com/#sle](http://www.jmeagle.com/#sle).
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage.
- C. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.
  3. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
    - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

## 2.8 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

- A. Manufacturers:
  1. AFC Cable Systems, a division of Atkore International: [www.afcweb.com/#sle](http://www.afcweb.com/#sle).
  2. Electri-Flex Company: [www.electriflex.com/#sle](http://www.electriflex.com/#sle).
  3. IPEX, a division of Aliaxis: [www.ipexna.com/#sle](http://www.ipexna.com/#sle).
- B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
- C. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for type of conduit to be connected.

## 2.9 INSIDE-PLANT FLEXIBLE NONMETALLIC COMMUNICATIONS RACEWAY/INNERDUCT

- A. Manufacturers:
  1. Eastern Wire + Conduit, a division of Atkore International: [www.easternwire.com/#sle](http://www.easternwire.com/#sle).
  2. Endot Industries: [www.endot.com/#sle](http://www.endot.com/#sle).
  3. Premier Conduit: [www.premierconduit.com/#sle](http://www.premierconduit.com/#sle).
- B. Description: Flexible, corrugated, nonmetallic communications raceway and associated fittings listed and labeled as complying with UL 2024; also suitable for installation as innerduct.
- C. Use only with approved cables in accordance with listing.
- D. Color: Orange, unless otherwise indicated.

## 2.10 ACCESSORIES

- A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.
- D. Foam Conduit Sealant:
  - 1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
  - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
  - 3. Rated to hold minimum of 10 ft water head pressure.
- E. Sealing Systems for Concrete Penetrations:
  - 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
  - 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
- F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
  - 1. Products:
    - a. Hilti; CFS-MSL Modular Fire Sleeve: [www.hilti.com/#sle](http://www.hilti.com/#sle).

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Galvanized Steel Electrical Metallic Tubing (EMT): Install in accordance with NECA 101.
- E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- F. Liquidtight Flexible Nonmetallic Conduit (LFNC): Install in accordance with NECA 111.
- G. Conduit Routing:
  - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
  - 2. When conduit destination is indicated without specific routing, determine exact routing required.
  - 3. Conceal conduits unless specifically indicated to be exposed.
  - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
    - a. Electrical rooms.
    - b. Communications rooms.
    - c. Mechanical equipment rooms.
    - d. Within joists in areas with no ceiling.
  - 5. Unless otherwise approved, do not route exposed conduits:

- a. Across floors.
  - b. Across top of parapet walls.
  - c. Across building exterior surfaces.
  6. Arrange conduit to provide no more than equivalent of two 90-degree bend(s) between pull points.
    - a. The equivalent of three 90-degree bends between pull points is permitted only under conditions described in BICSI TDMM.
  7. Arrange conduit to provide no more than 100 feet between pull points.
  8. Arrange conduit to provide minimum bend radii in accordance with BICSI TDMM.
  9. Maintain recommended separation from sources of EMI greater than 5 kVA in accordance with BICSI ITSIMM and BICSI TDMM.
  10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
  11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    - a. Heaters.
    - b. Hot water piping.
    - c. Flues.
  12. Group parallel conduits in same area on common rack.
- H. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
  3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
  4. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple, parallel, suspended conduits.
  5. Use of spring steel conduit clips for support of conduits is not permitted.
  6. Use of wire for support of conduits is not permitted.
  7. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.
- I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
  3. Use suitable adapters where required to transition from one type of conduit to another.
  4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
  5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
  6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
  7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect cables.
  8. Secure joints and connections to provide mechanical strength and electrical continuity.
- J. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves and/or slots for penetrations as indicated or as required to facilitate installation.
  4. Conceal bends for conduit risers emerging above ground.
  5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
  7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 84 00.
- K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed cables or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  3. Where conduits are subject to earth movement by settlement or frost.
- L. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
    - a. Where conduits enter building from outside.
    - b. Where service conduits enter building from underground distribution system.
    - c. Where conduits enter building from underground.
    - d. Where conduits may transport moisture to contact live parts.
  2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
    - a. Where conduits pass from outdoors into conditioned interior spaces.
    - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- M. Provide pull string in each empty conduit and innerduct/cell, and in each conduit where cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- N. Provide grounding and bonding.

### **3.3 FIELD QUALITY CONTROL**

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Correct deficiencies and replace damaged or defective conduits.

### **3.4 CLEANING**

- A. Clean interior of conduits to remove moisture and foreign matter.

### **3.5 PROTECTION**

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of cables.

**END OF SECTION**



SECTION 31 20 00 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation, filling, backfilling and compacting.
2. Trenching and trench backfilling.
3. Mass earthwork and rough grading.
4. Finish grading, including spreading of topsoil.
5. Dewatering.
6. Soil stabilization.
7. Testing and inspection.

B. Related Sections:

1. Division 02 Section "Selective Site Demolition".
2. Division 31 Section "Erosion Control".

1.2 QUALITY ASSURANCE

A. Testing and Inspection:

1. All testing and inspection shall be performed by an independent Geotechnical Engineering Consultant ("Geotechnical Engineer").
2. The Geotechnical Engineer is responsible for all testing, sampling and inspection.
3. The Geotechnical Engineer is responsible for approving materials, installation and procedures.
4. The Contractor is responsible for providing these services.
5. The Contractor is responsible for all coordination and scheduling with the Geotechnical Engineer.

B. Topsoil:

1. All topsoil shall be tested and approved by the Geotechnical Engineer.
2. Refer to 1.3 Submittals for more information.

- C. Any work in public right-of-way or other areas subject to the jurisdiction of any body shall be performed either to the requirements of that jurisdiction or to the requirements of this Specification, whichever is more stringent.

### 1.3 SUBMITTALS

- A. All submittals shall be reviewed approved by Architect/Engineer and Geotechnical Engineer.
- B. Product Data and Test Reports:
  - 1. Field and laboratory tests and inspections.
  - 2. Drainage fill: Include material specifications and sieve analysis. Include signed material certificate from manufacturer/supplier.
  - 3. Chemical modification: Include material specifications and signed material certificate from manufacturer/supplier.
  - 4. Geo-synthetic materials: Include material specifications and signed material certificate from manufacturer/supplier.
- C. Topsoil:
  - 1. Furnish topsoil analysis performed by the Geotechnical Engineer.
  - 2. Analysis shall state the following: (Refer to Part 2 for minimum requirements)
    - a. Percentage of organic matter.
    - b. Gradation of sand, silt and clay, Include USDA textural classification.
    - c. Cation exchange capacity.
    - d. Deleterious material.
    - e. pH.
    - f. Mineral and plant nutrient content (phosphorus, potassium, magnesium, calcium).
  - 3. Analysis shall state if topsoil is suitable for the intended use and as defined in this Specification, and shall state any requirements or recommendations necessary to make it suitable.
  - 4. Analysis shall state annual nutrient requirements and recommendations.
  - 5. This analysis is required for both on site and off site topsoil.
  - 6. Samples of the topsoil shall be taken under the following conditions:
    - a. Within four (4) weeks prior to placing topsoil, take three representative samples of proposed topsoil.
    - b. Within one week after placing topsoil, take three representative samples of in-place topsoil.
    - c. All samples shall be taken in witness of the Owner, in areas approved by the Owner. Contractor to coordinate with Owner as required.

7. Provide copies of all topsoil analysis and recommendations to Owner and Architect/Engineer.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. General:

1. All soil materials shall be approved by the Geotechnical Engineer.
2. All soil materials shall be suitable for each application.
3. Suitable soils are defined as soils which provide proper strength, compaction and drainage requirements and which are approved by the Geotechnical Engineer.
4. Fill material which is unsuitable due to excess moisture will not be classified as unsuitable if it can be dried to optimum moisture specified herein by manipulation, aeration or blending with other materials satisfactorily as approved by the Geotechnical Engineer.

#### B. Fill Materials:

1. Note: The following describes fill materials and their application for use. The materials shall be used for the listed applications, unless designated otherwise on the Drawings. If the Contractor has any questions or concerns regarding the materials or intended application, contact the Architect/Engineer for direction. Compaction requirements are the percentage of maximum dry density per ASTM D698 Standard Proctor Test, unless noted otherwise in the Geotechnical Report.
2. General fill:
  - a. Suitable on-site or off-site fill material free of debris, roots, organic and frozen materials, and stones having a maximum dimension of 2".
  - b. Minimum compaction: 95%.
  - c. Application: General filling and backfilling of excavations and trenches outside of the building.
3. Structural fill:
  - a. Suitable on-site or off-site fill material free of debris, roots, organic and frozen materials, and stones having a maximum dimension of 2".
  - b. Minimum compaction: 100%.
  - c. Application: Compacted subgrade under buildings, foundations and areas subject to structural loads.
4. Granular fill:

- a. Clean, natural or manufactured sand per requirements of INDOTSS Type "B" borrow, 4.75mm (No. 4) gradation. Pea gravel is not acceptable.
  - b. Minimum compaction: 95%.
  - c. Application: Backfilling of excavations and trenches which are under or within 5' of pavement, and underneath exterior concrete pavement, walks, curbs and slabs on grade.
5. Drainage Fill:
- a. General: Clean, washed fill sand with 100% passing the 4.75mm (No.4) sieve and no more than 5% passing the 0.075 mm (No. 200) sieve. Pea gravel or #53 stone are not acceptable.
  - b. Minimum compaction: 95%.
  - c. Application: Free draining material required for applications such as the outside of basement walls, the back side (earth side) of retaining walls and building slabs on grade.
6. Aggregate fill: Unless otherwise indicated, shall meet the following:
- a. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone and natural or crushed sand.
  - b. ASTM D2940, with 100 percent passing a 1 ½ inch sieve and not more than 8 percent passing a No. 200 sieve.
  - c. Application: base course under concrete and other items per plans.
7. Permeable soil mix:
- a. Permeable soil mix to promote infiltrate and allow runoff to filter through media and sustain vegetation.
  - b. Soil shall consist of the following:
    - a) 50-60% sand.
    - b) 20-30% compost.
    - c) 20-30% topsoil.
  - c. Clay is not permitted.
  - d. Shall have a minimum permeability rate of 1.0 feet per day (0.5 inches per hour)
  - e. Application: Rain Gardens and Bioswales.
- C. Topsoil:
1. Topsoil shall be fertile, friable, natural surface soil obtained from well-drained areas and possessing characteristics of representative soils in the project vicinity that produce heavy growths of crops, grass or other vegetation.

2. Topsoil shall consist of friable loam, reasonably free of subsoil, clay lumps, brush, roots, weeds or other objectionable vegetation, stones or similar objects larger than 1-1/2" in any dimension, litter or other materials unsuitable or harmful to plant growth.
  3. Supplement on-site topsoil with off-site topsoil as necessary.
  4. Unless otherwise indicated, minimum compacted thickness in lawn areas is 4".
  5. The mechanical analysis of topsoil shall be as follows:
    - a. 1" mesh sieve size; 99%-100% passing.
    - b. 1/4" mesh sieve size: 97%-99% passing.
    - c. No. 100 mesh sieve size: 40%-60% passing.
    - d. No. 200 mesh sieve size: 20%-40% passing.
  6. The following minimum requirements shall also be met:
    - a. Organic matter: 3-5%.
    - b. pH: 6.5 to 7.3.
    - c. Sand, silt, clay content: per USDA loam textural classification.
    - d. Minerals and nutrients: Per Geotechnical Engineer recommendations and amendments suitable for use in local area.
- D. Soil Separator Fabric:
1. Nonwoven, needle-punched geotextile fabric manufactured from polyolefins or polyesters per ASTM M288, suitable for subsurface drainage and other specified applications.
  2. Application: subsurface drains and as specified in Contract Documents.
  3. Specifications (values based on Mirafi 140N):
    - a. Apparent opening size: 70 (U.S. Standard Sieve Size); ASTM D-4751-99A.
    - b. Flow rate: 135 gpm/sf; ASTM D-4491-99A.
    - c. Puncture strength: 65 lbs; ASTM D-4833-00.
    - d. Mullen Burst: 225 lb/sq. in.
    - e. Grab tensile/elongation: 155 lbs/50%.
    - f. UV Resistance: 70% at 500 hours.
- E. Geo-synthetic Reinforcement:
1. General: TriAx Geogrid TX5 as manufactured by Tensar International Corp., Atlanta Georgia.
  2. Application: Soil stabilization as required and as recommended by the Geotechnical Engineer.
- F. Chemical Modification:
1. General: INDOTSS 215.

2. Materials: Hydrated lime per INDOTSS 913.04(b) and Type I Portland cement per INDOTSS 901-01(b).
3. Quantity: 4.0 +/- 0.5% by dry unit mass of the soils.
4. Application: If Geotechnical report indicates that chemical modification may be needed for soil stabilization, then Contractor shall include provisions for chemical modification in their bid.

G. Other Materials:

1. All other materials not specifically described but not required for proper completion of the Work of this Section, shall be as selected by the Contractor subject to the approval of the Architect/Engineer and Geotechnical Engineer.

### PART 3 - EXECUTION

#### 3.1 REQUIREMENTS

A. General:

1. Weather: Do not perform earthwork activities during inclement weather.
2. Dust: Use all necessary and appropriate means, such as water sprinkling, as required to prevent dust from being a nuisance to the Owner, public and concurrent performance of other work on the site.
3. Conflicts: Should the preceding job conditions or other items specified herein because actual or possible conflicts, notify the Architect/Engineer immediately and do not proceed until such conflict has been resolved.
4. Refer to Division 31 Section "Termite Control" for termite protection requirements.

B. Preparation: Verify that the following has been completed prior to beginning earthwork:

1. Protective fencing has been installed for trees and vegetation to remain.
2. Site clearing (clearing and grubbing).
3. Selective site demolition.
4. Erosion and sediment control measures are in place.

C. Protection:

1. For items indicated to remain, provide protection to prevent damage from construction activities. Any damage or destruction to items intended to remain intact shall be repaired or replaced to the satisfaction of the Owner at the Contractor's expense.
2. Topsoil: Protect placed topsoil from heavy machinery traffic. Remove and replace topsoil that is compacted by heavy machinery traffic.

3. Subgrade: Ditches and drains along the subgrade shall be maintained to drain effectively at all times. Repair subgrade of any ruts that may occur by reshaping and recompacting as required.
4. Utilities: Determine locations of existing utilities and the extent to which they may affect earthwork operations. Where service and utility lines are to remain, provide protection to prevent damage or disruption of services.
5. Damaged utilities shall be repaired immediately at the Contractor's expense.
6. Open excavation:
  - a. The Contractor is responsible for ensuring all open excavations are properly barricaded and protected at all times. This includes work such as mass excavation and trenching, and also includes other potentially dangerous conditions such as retention ponds.
  - b. Provide and install all necessary and appropriate means such as, but not limited to, signage, fencing, traffic barricades, and lighting to warn, discourage, and prevent danger to adjacent workers and general public.
  - c. Unless otherwise indicated, install a minimum 6' 10-gauge chain link fence around all open excavations, retention ponds, and other areas of potential danger, and maintain them while such conditions exist. Increase measures as required per site conditions.

### 3.2 LAYOUT

- A. Surveyor: Secure the services of a licensed land surveyor, acceptable to the Architect/Engineer and Owner, to layout locations of building, parking areas, drive, walks, curbs, finish elevations and other work, including mechanical and electrical items that are to be installed on the project site.
- B. References: Establish and maintain lines, corners, elevations and general reference points. Verify dimensions indicated on Drawings. If conflicts exist, immediately notify the Architect/Engineer before continuing work.

### 3.3 EXCESS WATER CONTROL

- A. Excess moisture: If excess moisture is present in soils, do not resume operations until moisture content and density are reported to be satisfactory by the Geotechnical Engineer.
- B. Flooding: Provide berms or channels to prevent flooding of subgrade. Promptly remove all water collecting in depressions.
- C. Softened subgrade: Where soil has been softened or eroded by flooding or placement during inclement weather, remove all damaged areas and recompact as specified for fill and compaction.

D. Dewatering:

1. Provide and maintain ample means and devices with which to promptly remove and dispose of all water from every source entering the excavations or other parts of the work at all times during construction.
2. Dewater by means which will ensure dry excavations and the preservation of the final lines and grades at bottom of excavations, such as sump pumps, trenching, etc.
3. Do not use extreme measures or durations as to cause adverse effects to Project Site or adjoining properties.

3.4 CHEMICAL MODIFICATION

A. General:

1. Scarify and/or disc area to a depth of 12" prior to distributing modifiers.
2. Utilize screw type, cyclone, or pressure manifold type distributors to apply modifier.
3. Do not apply when wind conditions create potential hazards or transference of material to adjacent areas.
4. Mix modifiers with rotary speed mixers or disc harrow, and continue until a homogenous layer of the required thickness is obtained.
5. Compaction:
  - a. Lime modified soils shall be compacted within 3 days.
  - b. Cement modified soils shall be compacted within 30 minutes.
6. Observation and testing: Quantities of materials, placing, mixing, and compacting shall be, as recommended, observed and tested by the Geotechnical Engineer.

3.5 STOCKPILING

A. General:

1. See drawings for designated stockpiling areas. If Drawings do not designate specific areas, or areas shown are insufficient, contact Architect/Engineer for direction.
2. Stockpile earth materials in manners that will prevent intermixing of different materials and intrusion of trash, debris and organic materials.
3. Slope stockpiled materials to provide adequate surface drainage.
4. Install and maintain erosion control measures. Refer to drawings and Division 31 Section "Erosion Control". At a minimum, silt fence shall be installed around all stockpiled areas. Seed areas which are to remain stockpiled for extended periods of time.
5. Storage or stockpiling of materials on the subgrade is prohibited.



3.6 EXCAVATION

A. General:

1. Excavation shall conform to OSHA and all other applicable safety regulations.
2. Excavation shall conform to the dimensions and elevations indicated on the Drawings, except as specified herein.
3. Excavation shall extend sufficient distance from walls and footings to allow for placing and removal of forms, installation of services and inspection.
4. Remove unsuitable material below indicated depths and replace with suitable, compacted material or lean concrete, at the Architect/Engineer discretion.
5. Topsoil stripping: Strip topsoil to its depth from areas to be covered by building, by walks and by other work and where existing surface areas required grading in order to establish new elevations.
6. Subgrade: Unless otherwise indicated, excavate to following subgrades:
  - a. Slab-on-grade: Sub-grade at bottom of drainage fill or at bottom of existing topsoil, whichever is lower.
  - b. Drives and paving: Sub-grade at bottom of aggregate base.
  - c. Footing: Sub-grade at indicated bottom of footing.
  - d. Lawn area: Sub-grade 4" below indicated surface elevation.

3.7 TRENCHING

A. General:

1. All trenching shall conform to OSHA and all other applicable safety standards.
2. Verification:
  - a. Contractor shall verify all existing grades, inverts, utilities, obstacles and topographical conditions prior to any trenching, excavation or underground installations.
  - b. In the event existing conditions are such as to prevent installations in accordance with the Contract Documents, immediately notify the Architect/Engineer and await decision before continuing work.
  - c. Architect/Engineer decision will be final and binding upon the Contractor, and installations shall be in accordance with same.
3. Saw cut existing pavements to proper width for trenching.
4. Legally dispose materials unsuitable for trench backfilling off-site.

B. Width:

1. Trenches for piping shall be not less than 12" wide or more than 16" wider than the outside diameter of the pipe to be laid therein, and shall be excavated true-to-line, so that a clear space not less than 6" or more than 8" in width is provided on each side of the pipe.
  2. For sewers, the maximum width of trench specified shall apply to the width at and below the level at the top of the pipe. The width of the trench above that level may be made as wide as necessary for sheeting and bracing, and proper installation of the Work.
  3. Trenches shall be open vertical construction.
- C. Depth:
1. Trench as required to provide the elevations shown on the drawings.
  2. Where elevations are not shown on the drawings, trench to sufficient depth to give a minimum of 36" of fill above the top of the pipes measured from the adjacent finish grade.
  3. Where trench excavation is inadvertently carried below proper elevation, backfill with approved material and then compact to provide a firm and unyielding subgrade and/or foundation at no additional cost to the Owner.
- D. Trench Bracing:
1. Properly support all trenches in strict accordance with all pertinent rules and regulations.
  2. Brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.
  3. In the event of damage to such improvements, immediately make all repairs and replacements necessary at no additional cost to the Owner.
  4. Arrange all bracing, sheeting, and shoring so as to not place stress on any portion of the completed Work until the general construction thereof has proceeded far enough to provide sufficient strength.
  5. All shoring and sheeting required to perform and protect the excavation and as required for the safety of employees and abutting structures shall be performed. All workmen performing work in 48" or deeper trench or excavation shall be protected by use of a welded sheet steel "safety box."
  6. Removal: Exercise care in the drawing and removal of sheeting, shoring, bracing, and timbering to prevent collapse or caving of the excavation faces being supported.
- E. Bedding:
1. Where pipes or conduits are to be installed, excavate below the proposed alignment of the pipe and backfill with clean sand to provide uniform support unless otherwise noted on the drawings.
  2. Unless shown otherwise on Drawings, minimum bedding to be 4" below pipe.
  3. Storm sewer pipes are to be bedded with stone.

4. Refer to drawings and details for further information and requirements.

F. Grading and Handling of Trenched Material:

1. During excavation, material shall be stacked in an orderly manner a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins.
2. Control the temporary stockpiling of trenched material in a manner to prevent water from running into the excavations.
3. Do not obstruct the surface drainage but provide means whereby stormwater is diverted into existing gutters, surface drains or other temporary drains.
4. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

3.8 FILLING, BACKFILLING AND COMPACTING

A. Prior to filling, backfilling and compacting, proof-roll and remediate subgrade per Part 3 Quality Assurance.

B. Unless otherwise indicated, maximum lift thickness is 8" of un-compacted material.

C. Moisture:

1. Thoroughly mix each layer to assure uniformity of material.
2. Supplement mixing with wetting or drying as required to obtain the moisture content required for the indicated percentages of compaction.
3. All fill shall be placed so that the moisture content is within +/- 2% of the optimum moisture content according to ASTM D698.
4. Do not use frozen materials in the fill or allow the fill to be placed upon frozen materials.

D. Compaction:

1. Compaction shall be accomplished by approved means and shall meet the following densities for various parts of the Work. See Part 2 for density requirements of individual soil materials.
2. Compaction by flooding is not acceptable.
3. In cut areas where pavement is planned, scarify the upper 12" of subgrade prior to compaction.

E. Equipment:

1. Tracked equipment shall not be used as compaction equipment.
2. The static weight of compaction equipment utilized for the compaction of backfill materials near walls as defined in No.3 below shall not exceed 2,000 lbs. for non-vibratory equipment and 1,000 lbs. for vibratory equipment.

3. All heavy equipment, including compaction equipment heavier than noted herein, shall not be allowed closer to walls than 3 feet plus the vertical distance from backfill surface to the bottom of the wall.

### 3.9 GRADING

#### A. General:

1. After filling and backfilling operations are complete, neatly and evenly grade areas to be seeded or sodded.
2. Scarify subgrade to a depth of 6" and place minimum 4" topsoil (6" maximum).
3. Grade to obtain the elevations indicated within a tolerance of plus or minus 0.1 foot.
4. Slope finished subgrade surface to provide drainage away from building walls.

#### B. Treatment After Completion of Grading:

1. After grading is completed and inspected, permit no further excavation, filling, or grading except with the review of and the inspection by the Owner.
2. Use all necessary means to prevent the erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

### 3.10 QUALITY ASSURANCE

#### A. Coordination:

1. A representative from the Geotechnical Engineer shall be present to observe and perform tests at all times earthwork is in progress.
2. Contractor shall provide minimum 72 hour notice to Geotechnical Engineer before each operation requiring testing or inspection.

#### B. Testing:

1. To verify adequacy of compaction, the Geotechnical Engineer shall perform field density tests.
2. A grid pattern shall be established with a maximum area of 1,000 square feet.
3. For each grid, provide minimum one test per each lift of compacted material.

#### C. Proofrolling:

1. Proofrolling shall be supervised by the Geotechnical Engineer.

2. Since standard test procedures are not available for proofrolling, the necessary scope and method of testing shall be determined by the Geotechnical Engineer, subject to review by the Architect/Engineer.
3. In areas to be covered by buildings and other site improvements, and other areas deemed necessary by the Geotechnical Engineer or Architect/Engineer, prepare and test subgrade as follows:
  - a. Using a loaded tri-axle dump truck or other approved method, the Contractor shall proof-roll the exposed subgrade under the observation of the Geotechnical Engineer.
  - b. Based on this observation, plus supplemental testing as required, the Geotechnical Engineer shall determine when and where soft, loose or other undesirable materials are to be removed and replaced.

D. Approval and Remediation:

1. When testing and proofrolling indicate proper compaction has been obtained, and after approval from Geotechnical Engineer has been given, continue fill and backfill work until the indicated elevation is achieved.
2. If required density has not obtained, the Contractor shall remove the defective material and repeat operations until the required density is obtained and approval is given by the Geotechnical Engineer.
3. Cost of material removal, replacement, compaction and re-testing shall be the responsibility of the Contractor.

3.11 SURPLUS SOIL MATERIALS

- A. Unless otherwise indicated or directed by Owner, remove excess soil materials and legally dispose of off-site.

3.12 JOB COMPLETION

- A. Upon completion of the Work of this Section:

1. Remove all trash and debris from earthwork operations.
2. Remove surplus equipment and tools.
3. Leave the site in a neat and orderly condition.
4. Restore all adjacent areas disrupted by earthwork activities to their original condition.

END OF SECTION 31 20 00



SECTION 31 23 23 - FLOWABLE FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flowable fill as shown or implied by the Contract Documents and as required to perform Work.
2. Backfilling pipe trenches for pipe structures, utility cuts and other work extending under pavement as indicated on the Drawings or as required by job conditions.

B. Related Sections:

1. Division 31 Section "Earthwork".
2. Division 32 Section "Site Concrete".

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent requirements of the following:
  - a. Indiana Department of Transportation Standard Specifications (INDOTSS), current Edition Section 213.
  - b. "Controlled Low Strength Materials" ACI 229.
2. Comply with the recommendations of American Concrete Institute for installation in hot and cold weather.
3. Where provisions of pertinent codes and standards conflict with this Section, the more stringent provisions shall govern.

1.3 SUBMITTALS

A. Mix design.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. Flowable Fill:

1. Cement: ASTM C150, Type I or III.
2. Fine Aggregate: ASTM C33.
3. Water: Clean, fresh, potable.
4. Air-entraining admixture: ASTM C260.
5. Fly ash: Not allowed.
6. Do not use calcium chloride or admixtures containing soluble chlorides. Fill shall not exceed maximum chloride ion content for corrosion as defined in ACI 318 Table 4.5.4.

### 2.2 MIX DESIGN

#### A. The flowable fill mix design shall meet the following requirements:

1. Unconfined 28-day compressible strength shall be 75-100 psi.
2. Flowable fill shall be hand tool excavatable.
3. Utilize a slower set (24 hour) mix.

## PART 3 - EXECUTION

### 3.1 GENERAL

#### A. Environmental Conditions:

1. Unless adequate protection is provided, do not place flow-able fill during rain, sleet or snow.
2. When extreme hot or cold weather conditions occur, or are expected to occur, which might detrimentally affect flow-able fill, employ handling and placing techniques to guard against such effects.

#### B. Preparation:

1. Remove all wood scraps, ice, snow, frost, standing water and debris from the area in which flowable fill will be placed.
2. Thoroughly wet the surface of excavations (except in freezing weather), coat forms with release agent, and remove all standing water.
3. Place flowable fill only on solid, dry and unfrozen substrate.



4. Pipes and objects subject to floating shall be securely strapped and anchored to prevent movement or displacement.
- C. Placing:
1. Convey flowable fill from mixer by methods that will prevent separation of materials.
  2. Deposit flowable fill as close as possible to its final position to avoid segregation.
  3. Flowable fill can be backfilled by granular material after the flowable fill can withstand the axial load of a #4 reinforcing rod, square end, without being penetrated with 150 lbs. pressure exerted concentrically (approximately 24 hour duration).

END OF SECTION 31 23 23



SECTION 31 25 00 - EROSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Prevention of soil or sediment leaving project site.
2. Prevention of soil or sediment impacting on-site or off-site activities or conditions.
3. Dust control.
4. Implementation of the approved construction storm water pollution prevention plan (SWP3).

B. Related Sections:

1. Division 02 Section "Selective Site Demolition".
2. Division 31 Section "Earthwork".
3. Division 32 Section "Seeding".

1.2 SUBMITTALS

A. Product data for the following:

1. Silt fence.
2. Inlet filters.
3. Erosion control blanket and fasteners.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Prior to beginning any earth disturbing activities, the Contractor shall verify with the Owner and ensure the IDEM Rule 5 Notice of Intent (NOI) has been filed. The Contractor may not begin any earth disturbing activities until a minimum 48 hours after the NOI has been filed.
2. Contractor shall coordinate with the Soil Water Conservation District or other agency having jurisdiction over erosion/sediment control and perform work as required and requested by such agency as outlined in the approved SWP3.

3. The standard for erosion/sediment control for this project is the Indiana Handbook for Erosion Control in Developing Areas, latest edition (Indiana Department of Natural Resources, Division of Soil Conservation). All erosion control work shall conform to this manual.
4. Contractor is required to remain in compliance with current erosion/sediment control standards and NOI.
5. The requirements of Indiana Administrative Code 327 IAC 15-5 shall be understood and adhered to by the Contractor for the duration of the project.

B. General Requirements:

1. Erosion/sediment control measures are to be installed prior to beginning any earth disturbing activities and maintained throughout construction.
2. The Contractor is responsible for ensuring all specified and necessary erosion/sediment control measures are installed, functioning and properly maintained.
3. Any fines or other costs incurred due to inadequate or improper installation, maintenance or performance of erosion/sediment control measures as identified by the self-monitoring process and/or other agency having jurisdiction over erosion control shall be the sole responsibility of the Contractor.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Silt Fence:

1. Woven or non-woven produced from 100% polypropylene, designed specifically to retain sediment and remain highly permeable to water.
2. Geotextile shall be attached to wood stakes with wood laths and staples or nails.
3. Bottom 12 inches of fabric shall be left unsecured to allow for entrenchment.
4. Stakes: 2" x 2" x 36" hardwood sharpened to a point on one end, maximum 5' spacing.
5. Lath: ½" x 1 ½" x 24" for attaching the fabric to the stakes.

B. Inlet Filters: Streamguard catch basin insert by Bowhead Environmental & Safety (800-909-3677), or Architect/Engineer approved equal.

C. Erosion Control Blanket:

1. Standard: Unless otherwise indicated, North American Green S150 BN or approved equal.
2. General: Woven, 100% biodegradable blanket, or approved equal.
3. Matrix: 100% straw fiber, 0.5 lbs/syd.
4. Netting: 100% biodegradable natural organic fiber.
5. Fasteners: 6" biodegradable plastic stakes.

- D. Refer to Division 32 Sections "Seeding" and "Planting" for temporary and permanent ground cover requirements.

## PART 3 - EXECUTION

### 3.1 REQUIREMENTS

#### A. General:

1. Prevent mud and dirt accumulations on all streets surrounding the project. Utilize stone tracking strips/construction entrances, street sweepers, spray trucks, power washers and other necessary and appropriate means as required. Roadways shall be kept clear of accumulated sediment that is a result of runoff or tracking.
2. Dust control: Use all necessary and appropriate means, such as water sprinkling, calcium chloride (AASHTO M 144), vegetative cover, spray-on adhesives, as required to prevent dust from being a nuisance to the Owner, public or concurrent performance of work on the site.
3. Keep the amount of disturbed area to a minimum at all times.
4. Seed immediately after grading soil, and install erosion control blanket where applicable.
5. Sequence installation of measures to ensure proper erosion control. See Drawings for basic sequencing requirements.
6. Temporary seed all areas that cannot be final seeded within a time period that will prevent soil erosion. For temporary seeding, utilize a fast growing seed of oats, annual rye grass, wheat or rye depending on the time of year.
7. See Division 32 Section "Seeding" for seeding requirements.
8. The Contractor shall post the Notice of Intent (NOI) letter near the main entrance to the site that includes contact information for the Contractor and site Owner and the location where project SWP3 plans may be found.
9. The Contractor shall inform all Subcontractors of the requirements of the Construction Stormwater Pollution Prevention Plan (SWP3) and its maintenance provisions, so that erosion/sediment disruption may be prevented by all those working on site.
10. Un-vegetated areas that are likely to be left inactive for more than 15 days must be stabilized.
11. Proper storage and handling of materials, such as fuels or hazardous wastes, and spill prevention and cleanup measures shall be implemented to minimize the potential for pollutants to contaminate surface or ground water or degrade soil quality. Notify Indiana Department of Environmental Management (IDEM) of any release.
12. Final stabilization for purposes of the Rule 5 regulations shall be achieved when all land disturbing activities have been completed and a perennial vegetative cover exists with at least a 70% density. Once this has been achieved, the Contractor shall notify the Owner and Architect/Engineer. The Contractor must still complete all maintenance and quality requirements as specified in Division 32 Sections "Seeding" and "Planting".

B. Self-Monitoring Program:

1. The Owner shall hire a trained individual to perform written evaluations of the project site weekly and after each rainfall of 0.5 inches or more. Additional evaluations shall be made when erosion control measures are first installed or reinstalled.
2. The written evaluations must address the maintenance of existing stormwater quality measures to ensure they are functioning properly and identify additional measures necessary to remain in compliance with Rule 5 Regulations (327 IAC 15-5).
3. The written reports shall include the name of the evaluator and the date of the evaluation. Copies of reports shall be sent to the Owner, Contractor and Architect/Engineer and kept on file for review on site.
4. The written reports shall be considered as observations and not specific direction to the Contractor. The trained evaluator shall not give direction to the Contractor without the Owner's consent.
5. The written reports shall contain problems identified at the site and recommended corrective action that should be taken. Observations of corrective actions shall also be recorded in the report.
6. All written reports shall be made available to the local inspecting authority within 48 hours of a request.
7. Direction from the self-monitoring process shall be given to the Contractor via the Owner or Architect/Engineer.

3.2 INSTALLATION

A. Silt Fence:

1. Install silt fence where indicated on Drawings and on other areas as required.
2. Follow all manufacturer guidelines for installation.
3. Dig a minimum 8" deep trench along proposed fence line to allow toe-in.
4. Install fence with stakes on the down stream/slope side.
5. Backfill and compact both sides of trench and ensure fence is anchored sufficiently.

B. Erosion Control Blanket:

1. Install blankets where indicated on Drawings and on other areas as required.
2. Follow all manufacturer guidelines for installation, including minimum overlapping and anchoring/stapling spacing.
3. Tuck the uppermost edge of the upper blankets into a check slot (slit trench, minimum 6" deep), backfill with soil and tamp down.
4. See drawings for additional installation requirements.

C. Stone Tracking Area/Construction Entrance:

1. Install at all temporary entrances/exits for construction traffic and in other areas as needed to prevent soil materials from being deposited on streets, parking areas, etc.
2. Minimum thickness is 6" of #2 stone. Increase as necessary for field conditions. Install geotextile fabric underneath stone to improve stability if needed.
3. Minimum dimensions are shown on the plans. Increase as necessary for field conditions.

### 3.3 INSPECTION AND MAINTENANCE

#### A. General:

1. Inspect all erosion control measures periodically and after each storm event.
2. Repair and replace all measures as necessary to ensure proper soil erosion prevention.
3. Maintain temporary measures until vegetation has been adequately established and construction activities have been completed to a point where the potential for soil erosion has been sufficiently eliminated. The Contractor is responsible for maintaining temporary measures until such a point and then removing the measures, even if all other construction work is complete.
4. Implement erosion/sediment control modifications as directed by the Architect/Engineer.

#### B. Silt Fence:

1. Inspect periodically and after each storm event.
2. If fabric tears, starts to decompose, or in any way becomes ineffective, replace the affected portion immediately.
3. Remove deposited sediment when it reaches 1/3 of the height of the fence at its lowest point or when it is causing the fabric to bulge. Do not undermine the fence during cleanout.
4. After the contributing drainage area has been stabilized, remove the fence and sediment deposits, bring the disturbed area to grade and stabilize.

#### C. Erosion Control Blanket:

1. During vegetative establishment, inspect after each storm event for any erosion underneath the blanket.
2. If any areas show erosion, pull back that portion of blanket, add soil, reseed, re-lay and re-anchor blanket.
3. After vegetative establishment, check the treated area periodically and repair as required.

#### D. Stone Tracking Area/Construction Entrance:

1. Inspect weekly and after storm events or heavy use.
2. Re-shape as needed for drainage and runoff control.
3. Top dress with clean stone as needed.

4. Immediately remove mud and sediment tracked or washed onto roads, parking lots, etc. by brushing or sweeping. Flushing is only to be used if the water is conveyed to a sediment trap or basin.

E. Inlet Filters:

1. Inspect each inlet periodically and after each storm event.
2. If fabric tears, starts to decompose, or in any way becomes ineffective, replace the affected portion immediately.
3. Remove deposited sediment often and do not allow to build up and cause damage to the fabric or reduce the flow capacity of the inlet.
4. Remove inlet fabric after the contributing drainage area has been stabilized.

F. Seeding:

1. Inspect temporary and permanent seeding periodically and after each storm event.
2. Repair damaged, bare or sparse areas by filling any gullies, re-fertilizing, over-seeding, re-seeding and re-mulching.
3. Install erosion control blanket over areas that do not hold.

G. Final Inspection and Acceptance:

1. Contractor shall notify the Owner in writing, 24 hours in advance that the project is ready for final inspection and acceptance. The following conditions must be met:
  - a. All land disturbing activities have been completed and the entire site has been stabilized.
  - b. All temporary erosion and sediment control measures have been removed.

END OF SECTION 31 25 00



SECTION 32 12 16 - ASPHALT PAVING

PART I - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt paving as shown or implied by Contract Documents.
2. Asphalt paving required as a result of trenching through or demolition of existing asphalt.

B. Related Sections:

1. Division 32 Section "Pavement Marking".

1.2 QUALITY ASSURANCE

A. All materials and work shall comply with the Indiana Department of Transportation Standard Specifications (INDOTSS), current edition.

B. Any work in public right-of-way or other areas subject to the jurisdiction of any body shall be performed either to the requirements of that jurisdiction or to the requirements of this Specification, whichever is more stringent.

C. Testing and Inspection:

1. All testing and inspection shall be performed by an independent Geotechnical Engineering Consultant ("Geotechnical Engineer").
2. The Geotechnical Engineer is responsible for all testing, sampling and inspection.
3. The Geotechnical Engineer is responsible for approving all materials, installation and procedures.
4. The Contractor is responsible for providing these services.
5. The Contractor is responsible for all coordination and scheduling with the Geotechnical Engineer.

1.3 SUBMITTALS

A. Materials Certificates:

1. Materials certificates must be signed by material supplier and Contractor.
2. Certificates must be submitted for all asphalt paving items.
3. Certificates must state that each material item meets or exceeds specified requirements.

B. Job Mix Formulas:

1. Submit a job mix formula (JMF) for all asphalt paving work.
2. The JMF must state that the mix meets the requirements of INDOTSS Section 402 as specified herein.
3. The JMF must include the following, at a minimum:
  - a. Aggregate type, source and gradation.
  - b. Type and percent of binder (actual and extracted).
  - c. Voids in mineral aggregate (VMA).
  - d. Voids filled with asphalt (VFA).
  - e. Percent of air voids.
  - f. Density.
  - g. Amount of recycled materials in intermediate course, if applicable.

C. Other:

1. Testing and inspection reports.

## PART 2 - PRODUCTS

### 2.1 PAVING

A. Aggregates:

1. Fine aggregates: INDOTSS Section 904.02
2. Course aggregates: INDOTSS Section 904.03
3. All crushed stone for the aggregate base shall be per the INDOTSS gradations and CAPP specifications.
4. Commercial grade aggregates are not acceptable.

B. Asphalt Materials:

1. General: INDOTSS Section 402.
2. Binder: Performance Graded Asphalt Binder, INDOTSS 902.01 (a).
3. Prime coat: Asphalt Emulsion, AE-PMP, INDOTSS 902.01 (b).
4. Tack coat: Asphalt Emulsion, AE-PMT, INDOTSS 902.01 (b).
5. Recycled asphalt materials:

- a. Per INDOTSS 401.06.
- b. Maximum 15% in the surface course.
- c. Maximum of 25% in the intermediate course.

C. Mixtures:

- 1. Percent of aggregates passing sieves.

Sieve Size	Surface	Intermediate
19.0 mm (3/4 in.)	100	100
12.5 mm (1/2 in.)	100	70-92
9.5 mm (3/8 in.)	96-100	50-75
4.75 mm (No. 4)	75±5	40±5
2.36 mm (No. 8)	36-66	18-45
1.18 mm (No. 16)	19-50	10-36
600 µm (No. 30)	10-38	6-26
300 µm (No. 50)	5-26	2-18
150 µm (No. 100)	2-17	0-11
75 µm (No. 200)	0-5	0-4
Percent of Bitumen	5.7 – 7.2	4.1 – 5.2
Percent Air Voids	4.0	4.0

- 2. Contractor is responsible for adjusting mix, if required for proper placement and performance. Any such modifications shall be approved by the Architect/Engineer.

- D. Unless otherwise indicated or required by jurisdictions having authority, a prime coat is to be used at the discretion of the Contractor, as necessary and appropriate to ensure proper protection and placement of paving.

PART 3 - EXECUTION

3.1 GENERAL

A. Protection:

- 1. Provide all necessary barricades and markers in order to keep vehicular traffic off freshly placed paving until the paving has cooled and hardened for at least twelve hours.
- 2. During paving operations, exercise care not to chip, spall, scar or otherwise damage curbs, walks, buildings and other work. Any such damage shall be repaired to the Owner's satisfaction by the Contractor at the Contractor's expense.

B. Job Conditions:

1. Weather limitations:
  - a. Apply prime and tack coats when ambient temperature is above 50 degrees F, (10 degrees C), and when temperature has not been below 35 degrees F, (1 degree C), for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
  - b. Place intermediate course when air temperature is above 30 degrees F, (-1 degree C), and rising.
  - c. Place surface course when air temperature is above 40 degrees F, (4 degrees C), and when intermediate course is dry.
2. Asphalt temperature: The paving mixture shall be placed and compacted at a temperature between 250°F (121°C) and 300°F (149°C).

### 3.2 PAVING

#### A. Grading and Drainage:

1. Ensure positive and adequate grading for all work. Notify Architect/Engineer of any concerns or conflicts prior to installation.

#### B. Preparation:

1. Immediately prior to placing the base course, proof-roll the sub-base with a pneumatic tire roller.
2. Remove and replace all areas of failures, irregularities and roller marks in the sub-base so that it meets the compaction requirements of Division 31 Section "Earthwork".

#### C. Placement:

##### 1. Aggregate base course:

- a. Place base course only on solid, dry and unfrozen subsurface.
- b. Unless specified otherwise on the Drawings, the aggregate base shall consist of the following minimum requirements: a 4" layer of compacted No. 53 crushed stone on top of a 4" layer of compacted No. 2 crushed stone, for a minimum overall compacted thickness of 8".

##### 2. Intermediate course:

- a. Immediately prior to the placing of the intermediate course, proofroll the aggregate base course by making a minimum of two passes over the entire areas

- with a pneumatic tire roller. Remove and replace all areas of failures, irregularities and roller marks in the base course.
- b. Place intermediate course only on clean, solid, dry and unfrozen sub-course.
  - c. Spread each course concurrently, within practical limits, using mechanical spreaders.
  - d. Intermediate course shall have minimum 3" compacted thickness, unless specified otherwise on the Drawings.
3. Surface course:
- a. Place surface course only on clean, solid, dry and unfrozen sub-course.
  - b. Apply tack coat to underlying surface as necessary to ensure proper placement.
  - c. Spread each course concurrently, within practical limits, using mechanical spreaders.
  - d. Surface course shall have minimum 1 1/2" compacted thickness, unless specified otherwise on the Drawings.
4. Abutting existing asphalt pavement:
- a. Saw cut the existing pavement straight and true.
  - b. Ensure new pavement elevation matches existing.
  - c. Ensure joint is clean and tight, with no gap or raveling.
  - d. Refer to Drawings for abutment detail.
- D. Compaction:
1. Aggregate base course:
    - a. Prior to compacting, remove any foreign materials that have become incorporated into the base course.
    - b. Thoroughly compact base course to the proper elevations and density.
  2. Intermediate and surface courses:
    - a. Prior compacting, remove any foreign materials that have become incorporated into the paving courses.
    - b. Follow the spreading processes immediately with rollers of sufficient size to compact the paving courses to their proper densities and elevations.
    - c. Ensure no low spots exist which might retain water.
    - d. Perform additional rolling as required to produce a well compacted, crack-free, fissure-free surface of uniform texture, without evidence of tool or machine marks.
    - e. Do not roll over the unprotected edge of a spread.

3.3 PATCHING

- A. Saw cut around areas to be patched or repaired.
- B. Remove existing pavement down to sound base, excavating with vertical faces.
- C. Replace with full depth patch, making neat, even and crisp joint with adjacent areas.
- D. Patched areas shall match adjacent areas in texture and grade.

3.4 FIELD QUALITY CONTROL

- A. Coordination:
  - 1. The Geotechnical Engineer shall be present to observe and perform tests at all times paving work is in progress.
  - 2. Contractor shall provide minimum 72 hour notice to Geotechnical Engineer before each operation requiring testing or inspection.
- B. Testing:
  - 1. Geotechnical Engineer shall take one sample per lift of asphalt concrete for each 5,000 square feet of pavement area, with a minimum of two samples per lift of asphalt concrete each day before paving operation. The following laboratory tests shall be performed:
    - a. Aggregate gradation.
    - b. Binder content.
    - c. Density.
    - d. Percent air voids.
  - 2. Geotechnical Engineer shall test in-place compacted asphalt for density with nuclear penetrometer (backscatter, no drilling of pavement). Geotechnical Engineer shall take one reading per lift of asphalt concrete for each 1,000 square feet of pavement area, with a minimum of two readings per lift of asphalt concrete each day. The in-place density shall be a minimum of 94% of the maximum theoretical density per the Job Mix Formula.
- C. Thickness:
  - 1. The in-place compacted thickness will not be acceptable if it exceeds the following allowable variation from the required thickness:
    - a. Base course:  $\frac{1}{2}$ ".
    - b. Intermediate course:  $\frac{1}{4}$ ".

c. Surface course:  $\frac{1}{4}$ ".

D. Surface Smoothness:

1. The finished surface will not be acceptable if it exceeds the following tolerances, using 10' straightedge applied parallel with and at right angles to centerline of paved area:
  - a. Base course:  $\frac{1}{4}$ ".
  - b. Intermediate course:  $\frac{1}{8}$ ".
  - c. Surface course:  $\frac{1}{8}$ ".
  - d. Finished grade shall be within  $\frac{1}{2}$ " of grade specified on the drawings.

E. Unsatisfactory Pavement:

1. Contractor is responsible for removing and replacing pavement that does not meet the Specifications herein, as well as any pavement deemed unacceptable by Architect/Engineer, Geotechnical Engineer or Owner.
2. The Contractor is responsible for the cost of any re-testing due to unsatisfactory pavement replacement.

### 3.5 COMPLETION OF WORK

A. At the completion of paving operations, the Contractor shall perform the following:

1. Remove all protective barricades and markers.
2. Clean paving materials from all structures, curbs, walks, mechanical and electrical items, and other surfaces to which the paving is incidental and not intended.

END OF SECTION 32 12 16





SECTION 32 13 00 - SITE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete outside of the building for site improvements including, but not limited to, the following:
  - a. Curbing, gutters, walks and pavement.
  - b. Equipment pads, light pole bases, utility trench protection and bollard anchorage.
  - c. Retaining walls, vaults, utility structures.
2. Precast concrete wheel stops.

B. Related Sections:

1. Division 32 Section "Pavement Marking".
2. Division 03 for structural concrete.

1.2 QUALITY ASSURANCE

A. Any work in public right-of-way or other areas subject to the jurisdiction of anybody shall be performed either to the requirements of that jurisdiction or to the requirements of this Specification, whichever is more stringent.

B. Qualifications of Workers:

1. Provide at least one person who shall be present at all times during execution of this portion of the work.
2. This person shall be thoroughly familiar with the type of materials being installed and the best methods for their installation.
3. This person shall direct all work performed under this Section.

C. Manufacturer: manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.

D. Codes and Standards:

1. In addition to complying with all pertinent codes and regulations, comply with all pertinent requirements of the following American Concrete Institute Publications:
  - a. "Building Code Requirements for Reinforced Concrete" ACI 318-99.
  - b. "Recommended Practice for Cold Weather Concreting" ACI 306 R-88.
  - c. "Recommended Practice for Hot Weather Concreting" ACI 305 R-91.
  - d. "Recommended Practice for Evaluation of Strength Test Result for Concrete" ACI 214-77.
  - e. "Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete" ACI 211.1-98.
2. Where provisions of pertinent codes and standards conflict with this Section, the more stringent provisions shall govern.

E. Testing and Inspection:

1. All testing and inspection shall be performed by an independent Geotechnical Engineering Consultant ("Geotechnical Engineer").
2. The Geotechnical Engineer is responsible for all testing, sampling and inspection.
3. The Geotechnical Engineer is responsible for approving all materials, installation and procedures.
4. The Contractor is responsible for providing these services.
5. The Contractor is responsible for all coordination and scheduling with the Geotechnical Engineer.

1.3 SUBMITTALS

- A. Mix Designs.
- B. Testing and inspection reports.
- C. Chloride ion tests or total chloride tests (with generally accepted method to relate total chloride to chloride ion) to show compliance with maximum ion concentrations.
- D. Mock-Ups:
  1. Flatwork: Minimum 6'x6' panel showing proposed surface finishes, joints and sealants.
  2. Exposed vertical surfaces (walls, steps, etc.): sufficient mock-up showing proposed finishes, joints, sealing, chamfering/radii, etc. as applicable.
  3. Do not install concrete without approval of both the Owner and Architect/Engineer.
- E. Detectable Warning Surface Paver.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete:

1. Cement: ASTM C150, Type I or III.
2. Fine aggregate: ASTM C33.
3. Coarse aggregate: ASTM C33.
  - a. Crushed stone shall be used for exterior concrete, unless otherwise noted.
  - b. Maximum aggregate size is 3/4 of the minimum clear spacing (per code) between reinforcing bars or between bars and forms.
4. Water: Clean, fresh, potable.
5. Air-entraining admixture: ASTM C260.
6. Fly ash: ASTM C618.
7. Fiber mesh:
  - a. Fiber mesh shall be polypropylene fibrillated and mix shall contain minimum 1.5 lbs. of fiber per cubic yard of concrete, unless otherwise prescribed by manufacturer and approved by Architect/Engineer.
  - b. Fiber shall be mixed at batch plant, field mixing is not acceptable.
8. Sealer/curing compound:
  - a. ASTM C309, Type I, clear.
  - b. Compatible with texture of surfaces.

B. Mix Design:

1. Strength: 4000 psi, ready mixed in accordance with ASTM C94.
2. Slump: 4" +/- 1".
3. Minimum cement content: 517 pounds per cubic yard (adjust for air entrainment)
4. Fly ash shall not replace more than 20% of the cement.
5. Maximum water/cement ratio: 0.40.
6. Air entrainment: 6%. Percentage of air content shall be determined in accordance with the admixture manufacturer's recommendations based on aggregate size and a moderate level of exposure.
7. White concrete must have a 3-year aged minimum SR value of 0.28, or initial SR value of at least 33.

C. Other Requirements:

1. Proportions of materials for concrete shall be established in accordance with Section 5.2 of ACI 318 (Latest edition).
  2. Follow ACI 211 and ACI 301 to determine the water-cement ratios.
  3. Concrete shall not exceed maximum chloride ion content for corrosion protection as defined in ACI 318 Table 4.4.1.
  4. Do not use calcium chloride or admixtures containing soluble chlorides.
  5. Do not use re-tempered concrete or concrete that has been contaminated by foreign materials.
  6. All exterior concrete shall be air entrained.
  7. Unless otherwise indicated, all reinforcing for concrete pavement shall be epoxy coated.
- D. Isolation Joints: Unless specified otherwise on Drawings, use the following:
1. Cork isolation joints with sealant:
    - a. Joint material: AASHTO M213; 1/2 inch thick.
    - b. Joint sealer: AASHTO M173; polyurethane with color matching adjacent concrete
    - c. Application: Use cork isolation joint with sealant for isolation joints for sidewalks, drop-offs, decorative concrete pavement areas, areas adjacent to buildings, structures, and columns.
  2. Asphalt saturated cellulosic fiber:
    - a. Joint material: AASHTO M213; 1/2 inch thick.
    - b. Do not place sealant on asphalt saturated cellulosic fiber isolation joints.
    - c. Application: Use this type of isolation joint for items such as curbs and walks, which are in areas not adjacent to buildings, structures and columns, etc. Do not use in areas of colored concrete.
  3. Contact Architect/Engineer if further direction is needed for proper application in specific areas.
- E. Detectable Warning Surface:
1. Concrete pavers:
    - a. Size: 12" x 12" x 2" thick excluding the dome height.
    - b. Pavers shall be resistant to road salts and common road pollutants.
    - c. Paver unit shall be suitable for traffic loads.
    - d. Truncated dome elements shall comply with current ADA requirements
  2. Cast iron plates: Detectable warning surface paver:
    - a. Shall be manufactured from gray iron in accordance with AASHTO M105, Class 30A.

- b. The tops of the domes and the space between domes shall have a non-slip textured surface.
- c. The minimum thickness of the casting shall be 0.30 inches excluding the dome height.
- d. Plates shall be resistant to road salts and common road pollutants.
- e. Plates shall be suitable for traffic loads.

## 2.2 STEEL REINFORCING

### A. Reinforcing Bars:

- 1. Reinforcing bars and dowels: ASTM A615, Grade 60.
- 2. Reinforcing to be welded: ASTM A615, Grade 40.
- 3. Epoxy coated bars and dowels: ASTM A884, Grade 60.

### B. Welded Wire Fabric:

- 1. ASTM A185 6"x6"xW1.4xW1.4, unless otherwise indicated.
- 2. Provide in flat sheets, not rolled form.

### C. Other Embedded Items: Provide standard manufactured products as approved by the Architect/Engineer.

### D. Bar Supports:

- 1. Conform to the requirements of the "Manual of Standard Practice", published by the Concrete Reinforcing Steel Institute.
- 2. Accessories shall be plastic protected Class "C" for all concrete exposed in the finished structure, except as specified below.
- 3. Accessories shall be Class "A", bright basic, for unexposed concrete.
- 4. Utilize Call "E," stainless steel bar supports, for exterior concrete to be finished by sand blasting.
- 5. Do not use continuous high chairs. Use individual high chairs laced with bottom cross bars plus #5 support bars. (Minimum of 2 rows of support for all reinforcing).
- 6. Supports must be capable of supporting construction loads without failing. Contractor to furnish additional supports at no cost to the Owner if in the Architect/Engineer estimation the supports are not adequate.

## 2.3 FORMWORK

### A. Form Lumber:

1. All form lumber in contact with exposed concrete shall be new or of sufficient quality to insure an unblemished texture.
2. All form lumber shall be plywood, board lumber, hardwood or other material of grade or quality to best suit each particular usage.

B. Fiber Forms:

1. Fiber forms may be utilized to construct round columns/piers.
2. Seamless forms must be used for concrete exposed in the finished structure.
3. Standard seamed tubes are permissible for non-exposed concrete.

C. Form Release Agent:

1. Standards:
  - a. Release agent shall be similar to Symons Manufacturing Company Magic Kote.
  - b. Grace Construction Products Formshield Chemical Release Agent.

D. Bracing/Shoring/Studs:

1. Such supports shall be selected for economy consistent with safety requirements and the quality required in the finished work. The Contractor is responsible for the design, illustration, safety and serviceability of all formwork.

E. Other Materials: All other materials, not specifically described, but required for proper completion of concrete formwork, shall be as selected by the Contractor subject to advance acceptance by the Architect/Engineer.

## 2.4 OTHER

A. Precast Concrete Wheel Stops:

1. Reinforced, precast concrete units 6" high x 9" wide x 7' long.
2. Provide minimum 2-#4 deformed bars 80" in length.
3. Provide chamfers on the top edges and drainage slots on the underside.
4. Anchor pins shall be 5/8" diameter deformed bars minimum 18" long.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. Job Conditions:

1. Extreme temperature conditions:
    - a. When extreme hot or cold weather conditions occur, or are expected to occur, which might detrimentally affect concrete, employ handling and placing techniques to guard against such effects.
    - b. Comply with the recommendations of American Concrete Institute for hot and cold weather concreting. ACI Publications ACI 306 and ACI 305.
  2. Inclement weather: Unless adequate protection is provided, do not place exterior concrete during rain, sleet or snow.
- B. Preparation and Verification:
1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly begin.
  2. Verify all items to be embedded in concrete are in place.
  3. Verify concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearances for reinforcement.
  4. Verify forms may be constructed in accordance with all pertinent codes and regulations, the referenced standards and the original design.
  5. Remove all dirt, oil, paint, loose rust and other foreign materials from the concrete reinforcement prior to placement.
  6. In the event of discrepancy, contact Architect/Engineer immediately and do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
  7. Verify approval of mock-ups by Owner and Architect/Engineer before beginning work.
- C. Other: Unless otherwise indicated, all exterior concrete shall be placed on a compacted aggregate fill per the following:
1. Minimum depth equal to the concrete thickness for pavement, walks and other slabs on grade.
  2. Minimum 6" depth of fill for curbing and other support bases.
- 3.2 FORMWORK
- A. Protection:
1. Use all necessary and appropriate means to protect formwork materials before, during and after installation.
  2. Protect the installed work and materials of all others trades.

3. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to Owner or other trades.

B. General:

1. Forms shall have sufficient strength and be sufficiently tight to prevent leakage of mortar.
2. The design and engineering of the formwork shall be the responsibility of the Contractor.
3. Refer to this Section for construction joint requirements.
4. Tolerances: Construct all forms straight, true, plumb and square within the tolerances recommended by ACI 347.
5. Embedded items: Set all required steel frames, angles, grilles, bolts, reglets, inserts, pipe, conduit and other such items required to be anchored in the concrete before the concrete is placed.
6. Wetting: Keep forms sufficiently wetted to prevent joints opening up before concrete is placed, except as recommended in ACI 306 R-78, "Recommended Practice for Cold Weather Concreting."

C. Layout:

1. Form all required cast-in-place concrete to the shapes, sizes, lines and dimensions indicated on the Drawings.
2. Exercise particular care in the layout of forms to ensure the proper finish structure size and shape.
3. Make proper provision for all openings, offsets, recesses, anchorage, blocking and other features of the Work as shown or required.
4. Carefully examine the Contract Documents and consult with other trades as required to ensure proper provisions for openings, reglets, chases, and other items in the forms.

D. Bracing and Shoring:

1. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to personnel.
2. Construct all bracing, supporting members, and centering of ample size and strength to safely carry, without excessive deflection, all dead and live loads to which they may be subjected.
3. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading.
4. All shoring shall extend to adequate foundations.
5. The Contractor is responsible for both the proper design and installation of all bracing and shoring, to properly insure the safety and serviceability of the structure.

E. Plywood Forms:



1. Assembly: Nail the plywood panels directly to studs and apply in a manner to minimize the number of joints.
  2. Joints: Make all panel joints tight butt joints with all edges true and square.
- F. Reuse of forms:
1. Reuse of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.
  2. Reuse of forms shall in no way impart less structural stability to the forms, nor less acceptable appearance to finished concrete.
- G. Cleaning:
1. Before concrete is placed the forms shall be cleaned of all debris, ice, snow, frost, and standing water.
  2. Remove all loose earth materials from the surfaces of earth forms.
- H. Removal of Forms:
1. Forms shall be removed in such a manner to ensure complete safety of the structure.
  2. Formwork for columns, walls, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations with the following minimums:
    - a. Formwork for walls and columns shall remain in place a minimum of two (2) days during which the temperature of the air surrounding the concrete must be above 50° F.
    - b. This minimum time period represents a cumulative number of days or fractions thereof.
    - c. Such formwork for concrete placed during cold weather with surrounding air temperatures 50° F shall remain in place one day after the artificial heating and/or freeze protection is discontinued/removed.
  3. Forms and false-work:
    - a. Any supporting vertical loads shall remain in place until the members have acquired sufficient strength to safely support their weight and any superimposed loads.
    - b. Such forming shall remain in place until the concrete has attained its specified 28 day strength as indicated by the test cylinders unless re-shores are installed in sufficient quantities to transmit the loads to adequate foundations without over stressing the particularly cured structure.
    - c. The requirements of ACI 305 and 306 must also be met before forms may be removed.

- d. Removal of forms and false-work is the responsibility of the Contractor, and the Contractor shall bear the full responsibility for this operation.
  - e. Concrete damaged by too early removal of forms or false-work shall be repaired or replaced as directed by the Architect/Engineer.
4. Concrete exposed by form removal during the curing period shall be cured by one of the methods specified in this Section.
  5. Curing compound is not permitted in certain locations. In these cases, curing is to be by an alternate method. Refer alternate methods in this Section.
  6. In no case shall the superimposed load or relatively new concrete exceed 50 pounds per square foot unless proper shoring to suitable foundations is installed as required by the Architect/Engineer.
  7. Use all necessary and appropriate means to protect workman, public, the installed work and materials of other trades, and the complete safety of the structure.
  8. Cut nails and similar fasteners off flush and leave all surfaces smooth and clean.

### 3.3 REINFORCEMENT

#### A. Protection:

1. Use all necessary and appropriate means necessary to protect concrete reinforcement before, during and after installation and to protect the installed work and materials of all other trades.
2. Store in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond-breaking coatings.
3. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

#### B. Placing:

##### 1. Reinforcing bars:

- a. Positively secure reinforcing to bar supports and tie or otherwise anchor bars to prevent displacement by construction loads or by the placing of concrete.
- b. Splice bars with a minimum lap of 40 bar diameters, unless otherwise indicated.
- c. Use mechanical splicers/couplers where quantity of reinforcement restricts placement of concrete if lapped splices are utilized.
- d. Splice bars only at locations indicated on the Contract Documents and shop drawings.
- e. Both shop and field bending shall be accomplished without heating the bars.
- f. Minor placing adjustments can be made to avoid interference with other reinforcement and/or embedded devices. The final arrangement, however, is subject to review and acceptance of the Architect/Engineer.



4. Use screed poles or similar devices to ensure that all slabs are cast at the proper elevations and that specified tolerances are maintained.

C. Rate of Placement:

1. Place concrete at such a rate that concrete is at all times plastic and flows readily between reinforcement.
2. Once placing is started, carry it on as a continuous operation until placement of the panel or section is complete.
3. Do not pour a greater area at one time than can be properly finished. This is particularly important during hot or dry weather.

D. Consolidation:

1. Thoroughly consolidate all concrete by mechanical vibration, hand, and other suitable means during placement, working it around all embedded fixtures and into corners of forms.
2. Do not over-consolidate with when using mechanical vibration as to cause separation of the aggregate.

### 3.5 JOINTS

- A. Unless otherwise shown on Drawings, joints shall meet the following minimum requirements. If questions or concerns exist, contact Architect/Engineer for direction.

B. Isolation Joints:

1. General:

- a. Tool concrete on both sides of joint (1/4" radius).
- b. Install joint material to full depth of concrete.
- c. See Part 2 Products for type of joint material to be used.
- d. Install sufficient smooth doweling reinforcing to prevent differential movement in curbing, walks and pavement.
- e. Do not dowel into such items as columns and exterior building walls/foundations, unless specified on drawings. Refer to structural drawings also.
- f. Unless otherwise indicated, install isolation joints per the following minimum requirements.

2. Curbing:

- a. Provide each side of inlet castings.
- b. Provide at all tangent points and changes in direction.

3. Walks:
    - a. For walks 6 feet in width and less, provide at intervals not exceeding 25 feet.
    - b. For larger walks and plaza areas, provide at intervals not exceeding 20 feet in any direction.
  4. Pavement: Provide at intervals not exceeding 20 feet in any direction.
  5. Retaining walls: Provide at intervals not exceeding 40 feet per linear length of wall.
  6. Other:
    - a. Provide at accessible ramps, buildings, columns, bollards, castings, drains and other locations as necessary to prevent excess cracking or displacement.
    - b. Contact Architect/Engineer if any areas of question or concern are encountered.
- C. Control Joints:
1. General:
    - a. Control joint depth shall be minimum  $\frac{1}{4}$  of the slab thickness.
    - b. Continue one half of reinforcing through joint.
    - c. Install joints by tooling or saw cutting as described below, unless otherwise indicated.
    - d. Construction joints may be used where appropriate.
  2. Curbing: Saw cut at intervals not exceeding 10 feet.
  3. Walks: Tool joints at intervals not-to-exceed 5 feet in any direction.
  4. Pavement: Saw cut at intervals not exceeding 18x pavement thickness feet in any direction.
  5. Retaining walls: Provide at intervals not exceeding 20 feet per linear length of wall.
  6. Other:
    - a. Provide at accessible ramps, columns, bollards, castings, drains and other locations as necessary to prevent excess cracking.
    - b. Contact Architect/Engineer if any areas of question or concern are encountered.
- D. Construction Joints:
1. Joints shall be made with properly constructed bulkheads and formed keyways.
  2. Extend reinforcing through construction joints, unless otherwise indicated.
  3. The Contractor shall consult with the Architect/Engineer before starting concrete work to establish a satisfactory placing schedule and to confirm joint locations.
  4. Retaining walls: Provide at intervals not exceeding 80 feet per linear length of wall.

- E. Tooled Joints and Scoring:
  - 1. Make straight, clean and non-ragged.
  - 2. Tool or score concrete on both sides of joint (1/4" radius).
  - 3. Provide window pane joint finish unless otherwise indicated.
- F. Bond Break: 15# per 100 square foot building paper.

### 3.6 FINISHING

- A. Unless otherwise indicated, provide a light-broom finish on all exterior slabs, walks and stairs.
- B. Provide a dry-rub finish for all exposed concrete walls, curbs or edge surfaces.

### 3.7 CURING

- A. Formed Surfaces:
  - 1. Cure formed surfaces by either of the following methods:
    - a. Leave forms in place until the cumulative number of days or fractions thereof, not necessarily consecutive, has totaled seven days during which the temperature of the air in contact with the concrete is 50°F or above.
    - b. Remove forms at an earlier time, but apply curing compound to concrete surfaces.
    - c. Apply compound in accordance with manufacturer's recommendations.
  - 2. If curing compound is not used and the forms are stripped prior to 7 days curing, the following methods are approved:
    - a. Ponding or continuous sprinkling.
    - b. Continuously wet mats.
    - c. Sand kept continuously wet.

### 3.8 PATCHING

- A. Patch existing concrete to receive new finish in a manner so that existing and patched surfaces are smooth and continuous and have a uniform appearance.

### 3.9 QUALITY ASSURANCE

- A. Coordination:

1. A representative from the Geotechnical Engineer shall be present to observe and perform tests at all times site concrete work is in progress.
2. Contractor shall provide minimum 72 hour notice to Geotechnical Engineer before each operation requiring testing or inspection.

B. Inspection:

1. Immediately after forms and curing membranes have been removed, inspect all concrete surfaces and patch all pour joints, voids, rock pockets, form tie holds and other imperfections before the concrete is thoroughly dry.
2. If the defects are serious or affect the strength of the structure, or if patching does not satisfactorily restore the quality and appearance of the surface, the concrete shall be removed and replaced complete, at no additional cost to the Owner.

C. Testing: The Geotechnical Engineer shall perform the following:

1. Compression tests:

- a. Secure three standard cylinders from each pour of concrete, in accordance with ASTM C31, and cure under standard moisture and temperature conditions.
- b. Test in accordance with ASTM C39.
- c. Test one cylinder at 7 days and two cylinders at 28 days.
- d. Submit duplicate test reports of results from testing to Architect/Engineer.
- e. Take steps immediately to evaluate unsatisfactory test results.
- f. In the event of unsatisfactory test results, an investigation as outlined in Section 5.6.5 of ACI 318-99 shall be employed.

2. Slump and air entrainment:

- a. Perform slump tests in accordance with ASTM C143.
- b. Determine the air content of concrete in accordance with ASTM standards.
- c. Submit results of slump tests and air content on each compression test report.

3. Should additional testing be required because of unsatisfactory test results, the Contractor is responsible for the costs incurred for correcting any deficiencies and the cost of additional testing.

3.10 DETECTABLE WARNING SURFACE

- A. Shall be installed per manufacturer requirements.
- B. Contractor shall warranty installed system for a period of three years from the date of substantial completion.

- C. Contractor shall provide owner with detectable warning surface units equal to 10% of the total units installed for future repairs.

END OF SECTION 32 13 00



## SECTION 32 17 23 - PAVEMENT MARKING

### PART 1 - PRODUCTS

#### 1.1 SUMMARY

A. Section Includes:

1. Pavement markings as shown or implied by Contract Documents.
2. Temporary striping and markings.

B. Related Sections:

1. Division 32 Section "Asphalt Paving".
2. Division 32 Section "Site Concrete".

#### 1.2 QUALITY ASSURANCE

A. All materials and work shall comply with the Indiana Department of Transportation Standard Specifications (INDOTSS) current edition, and Federal Specification TT-P-1952E.

B. Pavement markings in pedestrian ways or maneuvering areas to be skid resistant per ASTM E303 (<45 BPN)

C. All work shall meet requirements and recommendations of paint manufacturer.

D. Pre-construction Requirements:

1. Contractor shall conduct a pre-construction meeting with all applicable contractors/subcontractors, including but not limited to the painting installer and pavement/surface installer (i.e. concrete, asphalt), Owner and Architect/Engineer.
2. Verify paint materials and installation are compatible with surface in which paint will be applied.
3. Identify and convey any concerns or issues regarding the proper installation of the proposed pavement markings to the Owner and Architect/Engineer.
4. Do not proceed with work until all issues and concerns are resolved.
5. Contractor is solely responsible for ensuring proper installation of pavement markings.

### 1.3 SUBMITTALS

- A. Product Data:
  - 1. Pavement marking materials.
  - 2. Glass beads for reflectance.
  - 3. Other materials required for work of this Section.
  
- B. Material Certificates, which shall meet the following:
  - 1. Signed by material suppliers and Contractor.
  - 2. Submitted for all materials used.
  - 3. State each material meets or exceeds specified requirements.
  - 4. State each material is appropriate for proposed use and will produce successful results for each application.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Requirements:
  - 1. Paint shall comply with INDOTSS 909.05 (b) or (c).
  - 2. Accessible parking spaces are to be blue, refer to ADA Standards.
  - 3. Pavement marking color for parking stalls and traffic lanes shall match existing, unless indicated otherwise or directed by Architect/Engineer or Owner.
  - 4. On the exposed surfaces of curb throughout the width of curb ramps and curb transitions, apply silica sand per INDOT 808.06 to the wet paint at the rate of 6.0 lb/gal.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Protection:
  - 1. Protect the public from any nuisance or hazard from painting operations.
  - 2. Protect adjacent areas and property from painting operations. Immediately clean any surfaces in which paint is accidentally applied.
  - 3. Provide all necessary barricades and markers in order to keep vehicular and pedestrian traffic off painting until paint has dried sufficiently to prevent tracking.

**B. Job Conditions:**

1. Do not apply paint on wet surfaces, during wet or damp weather, or in windy conditions.
2. Do not apply paint when temperature is less than 40° F.
3. Do not apply paint over uncured asphalt or concrete.

**C. Preparation of Surface:**

1. Thoroughly clean surfaces of all dirt, dust, grease, oil, curing compounds (if used), and other foreign substances.
2. Unless otherwise indicated, paint existing markings black on asphalt pavement which are shown to be removed or are made obsolete by the new Work.
3. Verify with Architect/Engineer and Owner before utilizing any proposed mechanical, chemical, or other removal means.

**D. Application:**

1. Apply paint per manufacturer requirements and recommendations.
2. Do not paint in excess of the printed directions of the manufacturer.
3. The proposed method of applying paint shall be subject to approval of Architect/Engineer and Owner. Verify prior to installation.
4. Guides shall be used to form markings true to line and width, template the ends of stripes.
5. Over-painting of unsatisfactory areas shall be as directed by Architect/Engineer.
6. Minimum dry film thickness is 15 mils. App in two applications of 7.5 mils.
7. Unless otherwise indicated, stripe width is 4".
8. Size and shape of other markings are as indicated on the Drawings.

**E. Temporary Striping:**

1. Install as indicated in Contract Documents, as directed by Owner and as required during entire construction period.
2. Utilize an appropriate temporary paint, restripe as required during construction to maintain appropriate markings.
3. Unless otherwise indicated or directed by Owner, ensure temporary markings are absent and/or not visible with final Work.
4. Do not black out temporary markings or use mechanical or chemical means if markings are on finished surface. Ensure finished surfaces and Work are neat and clean and installed per Contract Documents and Owner expectations.

**F. Completion of Work:**

1. Remove all containers and waste materials from the site.
2. Remove protective barriers and markers after paint has dried sufficiently.

3.2 WARRANTY AND MAINTENANCE

A. Warranty:

1. Begin warranty period after date of Substantial Completion and continue for a period of one year.
2. Warranty shall ensure pavement markings meet specifications here within, as well as expectations of Owner and Architect/Engineer.

B. Maintenance:

1. During warranty period, restripe and otherwise remediate any markings as noted in paragraph A.2 above.
2. If remediation requires means other than applying new paint (i.e. mechanical, chemical, etc.) verify proposed remediation with Architect/Engineer and Owner prior to work.
3. During maintenance work, do not damage, disturb or otherwise affect Owner's property or any vehicles. Any such consequences shall be restored to original condition to Owner's satisfaction at Contractor's sole expense.
4. Contact Owner and coordinate all maintenance work, do not interrupt or interfere with Owner's operations.

END OF SECTION 32 17 23

SECTION 32 92 19 - SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Furnish and install all labor, material, and equipment necessary for seeding all areas as indicated or implied by the Contract Documents.

B. Related Sections:

1. Division 31 Section "Earthwork".

1.2 QUALITY ASSURANCE:

A. Installer Qualifications:

1. Engage an experienced installer who has completed seeding work similar in material, design, and extent to that indicated for this project and with a record of successful lawn establishment.
2. All work described in this Section is to be done by an installer specializing in such work within the five (5) documented years of experience in similar work.

B. Refer to Division 31 Section "Earthwork" for topsoil requirements and amendment recommendations to bring soil to optimal condition for growing lawn grass seed.

C. Applicable Publications:

1. Publications of the following institutes, associations, societies, and agencies are referred to in this Section.
2. American Joint Committee on Horticulture Nomenclature Standard: Standardized Plant Names, 1942 Edition and Additions.

D. Requirements of Regulatory Agencies:

1. Certificates of inspection: All shipments of orders of seed shall be properly inspected at the nursery or at the growing site by the authorized Federal and State authorities. All necessary inspection certificates shall accompany the invoice for each shipment or order of stock, as may be required by law for the necessary transportation. Certificates shall be filed with the Architect/Engineer, prior to acceptance of the materials.

1.3 SUBMITTALS

- A. Certification of grass seed from seed vendor for each grass seed mixture stating the botanical name, common name, and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for lawn seeding identifying source including name and telephone number of supplier.
- B. Topsoil analysis: Refer to Division 31 Section "Earthwork".
- C. One copy of Certificates of Inspection of Regulatory Agencies as specified herein.
- D. Qualification data for firms and persons specified in the "Quality Assurance" articles to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses; names and address of Owners and other information specified.

#### 1.4 SCHEDULING

- A. Seasonal Requirements:
  - 1. Perform the seeding work between 1 March and 15 May or between 15 August and 15 October, or both, unless otherwise approved by the Architect/Engineer; and at such time that the seeding work will not be damaged by freezing temperatures, rain or high winds.
- B. Scheduling:
  - 1. Seeding operations shall not commence in any area until other trades no longer need machine access to these areas.
  - 2. Begin installation of seeding after preceding related work is accepted.

#### 1.5 PRODUCT HANDLING

- A. Storage:
  - 1. Store in a dry, secure location off the ground, free from physical abuse.
  - 2. Protect from adverse weather conditions.

### PART 2 - PRODUCTS

#### 2.1 SEED

- A. Grass Seed: Fresh, clean, dry new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

- B. Seed Species: Seed of grass species as follows, with not less than 98 percent pure seed, not less than 85 percent germination, and not more than 0.3 percent weed seed:
  - 1. Permanent seed: Full sun or partial shade:
    - a. 90% Hybrid Bluegrass blend – a minimum of 3 varieties evenly blended, such as Midnight II, Rugby II, Nuglade, or as approved by Architect/Engineer.
    - b. 10% Perennial Rye Grass.
  - 2. Permanent seed: Full shade:
    - a. 20% Hybrid Bluegrass.
    - b. 40% Creeping Red Fescue.
    - c. 20% Hard Fescue.
    - d. 20% Chewings Fescue.
  - 3. Temporary seed:
    - a. 100% Annual Rye Grass.

## 2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C602 agricultural limestone containing a minimum 80 percent calcium carbonate equivalent as follows:
  - 1. Class: Class T with a minimum 99 percent passing through No 8 sieve and a minimum 75 percent passing through No 60 sieve.
- B. Aluminum Sulfate: Commercial grade, unadulterated
- C. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate
- D. Sand: Clean, washed, natural or manufactured, free of toxic materials.

## 2.3 ORGANIC SOIL AMENDMENTS

- A. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 – 4.8.
- B. Compost: Well-composted, stable and weed free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch sieve; not exceeding 0.5 percent inert contaminants and free of substances toxic to humans and plantings.

## 2.4 MULCHES

- A. Straw Mulch: Provide air dry, clean mildew and seed free, salt hay or thrashed straw of wheat, rye, oats, or barley.
- B. Non-Asphaltic Tackifier: Colloidal tackifier recommended by fiber mulch manufacturer for slurry application; nontoxic and free of plant material or germination inhibitors.
- C. Asphalt Emulsion: ASTM D977, Grade SS-1 nontoxic and free of plant-growth or germination inhibitors.

## 2.5 FERTILIZER

- A. Bone Meal: Commercial, raw or steamed, finely ground; a minimum 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial grade complete fertilizer of neutral character, consisting of fast and slow release nitrogen 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition: 12 percent of actual nitrogen, 12 percent phosphorous, and 12 percent potassium by weight.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water insoluble nitrogen, phosphorous, and potassium in the following composition:
  - 1. Composition: 20 percent nitrogen, 10 percent phosphorous and 10 percent potassium by weight.

## 2.6 WATER

- A. Potable.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Inspection:
  - 1. Verify soil preparation and related preceding work have been completed.
  - 2. Do not start work until other trades no longer need machine access to these areas.
  - 3. Do not start work until conditions are satisfactory.
- B. Preparation:



1. Protect structures, utilities, sidewalks, pavements and other facilities, trees, shrubs and plantings from damage caused by planting operations.
2. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties or walkways.

### 3.2 LAWN PREPARATION

- A. Limit lawn preparation to areas to be planted.
- B. Newly Graded Subgrades:
  1. Loosen subgrade to a minimum depth of 6".
  2. Remove stones larger than 1" in any dimension, sticks, roots, trash, and other extraneous matter.
  3. Apply soil amendments and fertilizer as recommended by topsoil analyst directly to topsoil before loosening.
- C. Unchanged Sub-grades: If lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:
  1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
  2. Loosen surface soil to a minimum depth of 6".  
Remove stones larger than 1" any dimension, sticks, roots, trash, and other extraneous matter.
  3. Apply soil amendments and fertilizers according to topsoil analysis and mix thoroughly into top 6 inches of soil. Till soil to a homogeneous mixture of fine texture.
- D. Finish Grading:
  1. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture.
  2. Grade to within plus or minus 1/2 inch of finish elevation.
  3. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
- E. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Restore areas if eroded or otherwise disturbed after finish grading and before planting.
- G. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

### 3.3 SEEDING

- A. General:
  1. Sow seed with spreader or seeding machine.
  2. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

3. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
4. Do not use wet seed or seed that is moldy or otherwise damaged.
5. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.
6. Unless otherwise indicated, sow seed at the rate of 4 to 6 lb/1000 sq. ft.

B. Slope Protection:

1. On slopes 5:1 and steeper, install erosion control blanket.
2. On slopes less than 5:1, install straw mulch.
  - a. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas.
  - b. Spread by hand, blower, or other suitable equipment.
  - c. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.

3.4 HYDROSEEDING

- A. Hydro-seeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydro-seed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with non-asphaltic or asphalt-emulsion tackifier.
- B. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate.

3.5 PROTECTION

- A. Description:
1. Erect temporary barricades and warning signs to protect against pedestrians and vehicular traffic.

3.6 CLEANING

- A. Description:
1. Immediately clean spills from paved and finished surface areas.
  2. Remove debris and excess materials from project site.
  3. Dispose of protective barricades and warning signs at termination of lawn establishment.
  4. Remove erosion control measures after lawn establishment period.

3.7 LAWN ESTABLISHMENT

- A. Watering:
  - 1. Water daily for the first 14 days after seeding.
  - 2. After first 14 days, supplement rainfall to produce a total of 2 inches water per week until lawn is clearly established and growing healthy.
  
- B. Mowing:
  - 1. When grass reaches 2-1/2 inches in height, mow to 1-3/4 inch in height.
  - 2. Maintain grass between 1-3/4 inch and 2-1/2 inch height.
  - 3. Do not cut off more than 40% of grass leaf in single mowing.
  - 4. Remove grass clippings.
  - 5. Re-seed spots larger than 1 square foot not having uniform strands of grass.
  
- C. Weed Eradication:
  - 1. Between second and third mowing, apply herbicide uniformly at manufacturer recommended rate.
  
- D. Fertilizer:
  - 1. Apply fertilizer uniformly at 1 lb of nitrogen per 1000 square feet 30 days and 60 days after seeding and water immediately.
  
- E. Satisfactory Seeded Lawn:
  - 1. At end of maintenance period, a healthy, uniform, close stand of grass has been established free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 inches by 5 inches.

### 3.8 WARRANTY AND MAINTENANCE

- A. Begin maintenance of lawns immediately after each area is seeded and continue until acceptable lawn is established, but not less than 60 days after date of Substantial Completion.
  - 1. If full maintenance period has not elapsed before the end of planting season, or if lawn is not fully established, continue maintenance during the next planting season.
  - 2. Maintenance includes watering, fertilizing, weeding, mowing, trimming, replanting, and other operations to provide a uniform, weed free, smooth lawn.
  
- B. Begin warranty period after date of Substantial Completion and continue for a period of (one full year).
  - 1. Warranty specified in this section does not deprive the Owner of other rights; he may have in these specifications.

2. The warranty period for new lawn areas shall be for (one full year) after date of Substantial Completion against defects including death and unsatisfactory growth except for defects resulting from Owner abuse or neglect or incidents beyond Contractor's control.
3. Replacement seeding under this warranty shall be granted for (one full year) from date of installation and acceptance.
4. The Contractor shall, at no cost to the Owner, repair damage done to walks, buildings, roads, and other plants or lawns during reseeding.
5. Inspection of the lawn to determine its completion for the beginning of the warranty period will be made by the Architect/Engineer upon notice requesting such inspection by the Contractor at least seven (7) days prior to the anticipated inspection date.

3.9 FINAL INSPECTION AND ACCEPTANCE

A. Description:

1. Request final inspection in writing for acceptance at least ten (10) days before end of warranty period.
2. At the end of the warranty period on the completed lawn, and on written notice from the Contractor, the Architect/Engineer will, within 15 days of such written notice, make an inspection of the lawn to determine if a satisfactory stand of grass has been produced.
3. If a satisfactory lawn has not been established, another inspection will be made after written notice from the Contractor that the lawn is ready for inspection following the next growing season.

END OF SECTION 32 92 19

SECTION 33 05 00 – COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. All utility systems 5 feet outside the building line, as shown or implied in the Contract Documents and as required for the Work, including but not limited to:
  - a. Sanitary sewerage.
  - b. Storm drainage.
2. Contractor is responsible for all utility work as shown on contract documents or as required, unless specifically indicated otherwise.

B. Related Sections:

1. Division 02 Section "Maintenance of Existing Conditions".
2. Division 33 Section "Sanitary Sewers".
3. Division 33 Section "Storm Drainage".

1.2 SUBMITTALS

- A. Warning Tape System.

1.3 DEFINITIONS

- A. Utilities include all underground and above ground piping, conduits, cables and related structures and appurtenances. Utilities also include sewers.
- B. "Utility Companies" as referenced herein includes all public, private and other companies and agencies supplying utility services or having jurisdiction over such services.

1.4 QUALITY ASSURANCE

- A. All materials and installation shall meet the requirements of utility companies.

- B. All installation shall meet the requirements and recommendations of the material manufacturers and suppliers.
- C. All installation shall meet the requirements and recommendations of the material manufacturers and suppliers.

#### 1.5 COORDINATION

- A. All installation shall meet the requirements and recommendations of the material manufacturers and suppliers.
- B. Verify all proposed utility work with utility companies prior to beginning work.
- C. Provide sufficient notice to utility companies for all work affecting services of utility companies.
- D. Contractor shall maintain complete and operable utility services at all times.
- E. Coordinate timing of utility work and temporary measures with Owner and Utility Companies.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Warning Tape:
  - 1. Verify warning tape requirements with Utility Companies, Owner and Architect/Engineer prior to installation. Unless otherwise indicated or required, provide per the following.
  - 2. Color:
    - a. Blue: Water, fire and chilled water lines.
    - b. Red: Electric.
    - c. Orange: Telecommunications.
    - d. Yellow: Gas, oil, steam, dangerous materials.
    - e. Green: Sanitary laterals
  - 3. Use one of the following systems:
    - a. Non-detectable warning tape with toning wire below:
      - 1) Acid- and alkali-resistant polyethylene warning tape manufactured for marking and identifying underground utilities, 6" inches wide and 4 mils thick.
      - 2) Label: continuous "CAUTION—BURIED (name of utility) BELOW". Toning wire: 12 gauge copper wire with protective jacket for corrosion protection.

- 3) Unless otherwise indicated, install warning tape 18" below finished grade with toning wire 12" below warning tape.
  - 4) Turn up and tie toning wire as indicated or as required by Utility Companies and Owner.
- b. Detectable warning tape:
- 1) Acid- and alkali-resistant polyethylene warning tape manufactured for marking and identifying underground utilities, 6" inches wide and 4 mils thick with metallic core with protective jacket for corrosion protection.
  - 2) Label: continuous "CAUTION—BURIED (name of utility) BELOW".
  - 3) Unless otherwise indicated, install warning tape 18" below finished grade.
- B. Unless otherwise indicated or required, warning tape does not apply to sewers or subsurface drains.
- C. Refer to individual Sections for further utility product specifications.

### PART 3 - EXECUTION

#### 3.1 REQUIREMENTS

- A. General:
1. New utilities shall be installed and operational prior to displacing existing utilities. Service must be maintained at all times.
  2. All work shall be made readily accessible for inspection by Utility Companies and Owner at all times during working hours.
  3. Refer to Division 31 Section "Earthwork" for excavation, trenching and backfilling.
- B. Preparation:
1. Verify existing utilities and topographic conditions prior to trenching, excavation or installation.
  2. If existing field conditions prevent installation per the contract documents, notify the Architect/Engineer immediately.
  3. Review proposed utility work prior to installation and notify Architect/Engineer immediately of any conflicts or concerns.
  4. Mark underground utilities prior to beginning any excavation or other underground work in area of proposed activity.
- C. Installation:

1. Provide and maintain all necessary stakes, benchmarks and batter boards for installing utilities to alignment and grades.
2. During backfilling, install continuous warning tape over all utilities. Install tape full length of utility and terminate properly to allow for charging of tape or toning wire. If utility is installed by Utility Companies, provide warning tape and coordinate installation.

END OF SECTION 33 05 00



SECTION 33 30 00 - SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary sewers outside of the building.

B. Related Sections:

1. Division 33 Section "Common Work Results for Utilities".

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with the requirements of the utility company which receives the wastewater and otherwise has authority over the sanitary infrastructure "Sanitary Utility".
2. All materials and work within the right-of-way or easement of any local government or other agency having jurisdiction over sewerage, shall meet the requirements of such agency.
3. All sanitary work and testing shall conform to the Indiana Department of Environmental Management (IDEM) and the Indiana State Department of Health (ISDH).

1.3 SUBMITTALS

- A. General: Each item in submittal must state that the item meets or exceeds the specified standards referenced herein. In addition, if multiple sizes or types are included in the submittal, clearly indicate which is to be used, and where, if applicable.

B. Product Data:

1. Sewer pipe, fittings and joint materials.
2. Pipe connectors (flexible connectors into sanitary manholes).
3. Cleanouts.

C. Shop Drawings:

1. Pre-cast concrete manholes, including castings, steps, sealing materials and any other required appurtenances.
- D. Test Reports: Submit results for all testing and inspections to Architect/Engineer.

## PART 2 - PRODUCTS

### 2.1 PIPE AND FITTINGS

A. Notes:

1. Unless otherwise indicated, pipe sizes refer to the nominal inside diameter.
2. Unless otherwise indicated, the following materials shall be used as described below.

B. Sanitary Sewer:

1. Polyvinyl chloride (PVC) pipe and fittings (6" through 15"):
  - a. Pipe: ASTM D3034, SDR-35.
  - b. Fittings: ASTM D3034, SDR-35.
  - c. Joints: ASTM D3212, compression type bell and spigot.
  - d. Gaskets: ASTM F477, elastomeric.
2. Polyvinyl chloride (PVC) pipe and fittings (18" through 24"):
  - a. Pipe: ASTM F679, T-1 wall thickness.
  - b. Fittings: ASTM F679, T-1 wall thickness.
  - c. Joints: ASTM D3212, compression type bell and spigot.
  - d. Gaskets: ASTM F477, elastomeric.
3. Ductile iron pipe and fittings (6" and larger):
  - a. Pipe: AWWA C151, pressure class 350.
  - b. Fittings: AWWA C110, standard pattern or AWWA C153 compact pattern.
  - c. Joints: bell and spigot with push-on joints and gaskets.
  - d. Gaskets: AWWA C111, rubber.
  - e. Interior lining: epoxy coating (do not use cement mortar lining).
  - f. Exterior coating: standard asphaltic per AWWA C151.
  - g. Polyethylene encasement: AWWA C105 tube or sheet, Linear Low Density (LLD, minimum 8 mil) or High Density Cross Laminated (HDCL, minimum 4 mil) with 2" polyethylene tape (minimum 12 mil).

- h. Application: Required when crossing water lines with less than 18" vertical or 10' horizontal clearance.

## 2.2 EXTERIOR CLEANOUTS

### A. General:

1. Unless otherwise indicated, cleanouts shall be the same diameter as the sewer they serve for pipe sizes up to 8", pipes greater than 8" shall use an 8" cleanout.
2. Unless otherwise indicated, riser pipes and cleanout bodies shall be the same material as the sewer they serve.
3. Each cleanout shall have an exterior housing to prevent transfer of load to the cleanout.
4. Medium duty housings may be used in non-vehicular areas, all others shall be heavy duty.
5. Exterior housing:
  - a. ASME A112.36.2M gray iron with round, secured, scoriated and gray iron cover.
  - b. Refer to Part 3 for concrete anchorage.
6. Cast iron cleanouts:
  - a. Gray iron ferrule with tapered-thread, brass closure plug, ASME A112.36.2M.
  - b. Riser pipe and fittings: cast iron soil pipe, ASTM A74.
  - c. Ferrule connection may be inside caulk, spigot or no-hub. Connection must be water and air-tight.
7. Plastic cleanouts:
  - a. PVC body with PVC tapered-thread plug.
  - b. Riser pipe and fittings: SDR 35, ASTM D3034.

## 2.3 MANHOLES

### A. General:

1. Precast concrete per ASTM C478 and watertight, See Part 3.
2. Manhole base shall be minimum 8" thick. To prevent flotation, increase the thickness of precast sections or add concrete to base section as required.
3. Steps: Polypropylene encased #4 rebar per ASTM D4101, meeting OSHA requirements.
4. Castings: All frames and castings shall be heavy duty and constructed of gray iron free from blowholes, porosity, hard spots, shrinkage distortion, etc. They shall be smooth and clean. Watertight manhole covers shall be used for any sanitary manhole located within a floodplain, floodway or other areas subject to flooding.

5. Adjusting rings: Precast concrete, interlocking with ½ butyl rubber base or extrudible preformed gasket material. Bricks, blocks or other means are not acceptable.
6. Pipe connectors: each pipe entering a sanitary manhole shall have a gasketed, flexible, watertight connector per ASTM C923.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

##### A. Piping:

1. Install PVC gravity sewer piping according to ASTM D2321.
2. Install cleanouts and manholes in sewer lines where shown on the Drawings and as required by applicable Codes and/or field conditions.
3. Install manholes and cleanouts at all changes in direction. Blind turns or gradual deflection of pipe is not permitted.
4. The maximum distance between manholes is 400’.
5. Verify existing and proposed grades before installing any pipe. Notify Architect/Engineer of any conflicts with Drawings or Specifications.
6. Pipe installation shall proceed upgrade with spigot ends of bell and spigot pipe pointing into direction of flow. Each pipe shall be laid true to line and grade and in such a manner as to form a close concentric joint with adjoining pipe and to prevent sudden offset in the flow line.
7. Pipe trenches shall be excavated parallel to the specified pipe, slope and grade. The bottom of the pipe shall be supported by a minimum 6” thick layer of #8 crushed stone. The #8 crushed stone shall extend 6” on each side of the pipe and 12” above the top of the pipe. The remaining backfill in lawn and non-pavement areas shall be suitable fill material approved by the Geotechnical Engineer. Pipes under and within 5’ of pavements, slabs, sidewalks and other hard surfaces shall be backfilled with compacted granular fill. All backfilling and compaction shall be in accordance with Division 31 Section “Earthwork”.
8. During backfilling, install detectable warning tape. See Division 33 Section “Common Work Results for Utilities” for warning tape requirements.
9. Any breaks or defects in pipe must be immediately repaired. Any pipe which has been disturbed after being laid must be taken up, joints cleaned and properly relaid.
10. Interior of all pipe shall be cleaned of all dirt and superfluous materials as the work progresses. After pipe installation, install erosion control measures as shown on Drawings and as necessary to prevent sediment or other materials from entering or building up in pipe.
11. Water and sewer minimum clearances:

- a. Where minimum 18" vertical or 10' horizontal separation cannot be provided between sewers and water lines, the sewer shall be ductile iron, refer to Part 2.
- b. At crossings, extend ductile iron sewer pipe a minimum of 10 feet on both sides of the water line.
- c. Do not install water and sewer lines in the same trench under any circumstances.

B. Manholes:

1. Set castings flush with grade in pavement areas and 1" above grade in other areas.
2. Install 2 to 4 precast adjusting rings for an overall 6" to 12" adjustment height.
3. Grade to drain away from castings.
4. Install steps from 12" below top to 12" above bottom at 16" on center.
5. Bench bottom of manholes per Drawings.
6. If required by Sanitary Utility, apply mastic or other approved sealing material to outside of sanitary manholes per Sanitary Utility's specifications.

C. Cleanouts:

1. Install piping so cleanouts open in direction of flow in sewer pipe.
2. Set cleanout covers flush with grade.
3. In areas other than concrete walks and concrete pavements, install concrete anchor pad.
4. Unless otherwise indicated, pad dimensions are 12" height with a diameter of the cleanout housing diameter + 12", to provide a 6" ring around the cleanout frame. Place on properly compacted subgrade and stone per Division 31 Section "Earthwork" and Division 32 Section "Site Concrete".

### 3.2 SANITARY SEWER TESTING

A. General:

1. The Contractor is responsible for all costs for testing and inspection, including labor, equipment and supplies.
2. The Contractor is responsible for coordinating and scheduling testing.
3. Any work failing testing and inspection requirements shall be repaired or replaced at the Contractor's expense and re-tested.

B. Requirements:

1. Testing and inspection shall meet all requirements of local Sanitary Utility and applicable State regulations. Contractor shall contact local Sanitary Utility to verify testing and inspection requirements.

C. Gravity Sewer Pipe:

1. Deflection test: No sooner than 30 days after the installation, backfill and final compaction, each flexible sewer pipe shall be tested for deflection. No pipe shall exceed a deflection of 5%. The diameter of the mandrel shall be no less than 95% of the inside diameter of the pipe. The test shall not be performed with the aid of a mechanical pulling device.
2. Air pressure test: Each flexible sewer pipe shall be air pressure tested and conform to ASTM F1417. The leakage exfiltration or infiltration shall not exceed 200 gallons per inch of pipe diameter per mile per day for any section of pipe with a minimum positive head of two feet.

D. Manholes:

1. Each manhole shall be visually inspected after installation, backfilling and final compaction. If manhole shows leakage or signs thereof, it shall be repaired to the satisfaction of the Architect/Engineer and reinspected.
2. Vacuum test: Each manhole shall be air tested and conform to ASTM C1244.

END OF SECTION 33 30 00

SECTION 33 40 00 – STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Storm sewers and drainage structures outside of the building.
- B. Related Sections:
  - 1. Division 33 Section “Common Work Results for Utilities”.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. All materials and work within the right-of-way or easement of any local government or other agency having jurisdiction over storm drainage, shall meet the requirements of such agency.

1.3 SUBMITTALS

- A. Each item in submittal must state that the item meets or exceeds the specified standards referenced herein. If multiple sizes or types are included in the submittal, clearly indicate which are to be used, and where, if applicable.
- B. Product Data:
  - 1. Sewer pipe, fittings and joint materials.
  - 2. Frames and grates.
  - 3. Steps.
  - 4. Cleanouts.
  - 5. End sections.
- C. Shop Drawings: Reinforced concrete manholes, inlets, and any other structures, including steps, sealing materials and any other required appurtenances.
- D. Test Reports: Submit results for all testing and inspections to Architect/Engineer.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Unless otherwise indicated, pipe sizes refer to the nominal inside diameter.
- B. Unless otherwise indicated, the following materials shall be used as described below.
  - 1. Reinforced concrete pipe (RCP):
    - a. ASTM C76, Class III, Wall B.
    - b. Bell and spigot joints with rubber gaskets ASTM C443.
    - c. Application: Storm sewers 12" and larger.
  - 2. High density polyethylene (HDPE) pipe and fittings:
    - a. ASTM D3350 and AASHTO M294 Type S, corrugated with smooth interior wall.
    - b. Silt-tight joints ASTM D3212 with ASTM F477 gaskets.
    - c. Application: Storm sewer 12" to 36" where sewer has a minimum cover of 3 feet from top of pipe to top of finished grade.
  - 3. Polyvinyl chloride (PVC) pipe and fittings:
    - a. SDR 35 ASTM D1784, ASTM D3034.
    - b. Compression type bell and spigot joints ASTM D3212 with ASTM F477 gaskets.
    - c. Application: Storm sewer 12" and smaller which runs directly from building. Do not use in between storm structures or for culverts.
  - 4. Ductile iron (DI) pipe and fittings:
    - a. Pipe: AWWA C151, pressure class 350.
    - b. Fittings: AWWA C110, standard pattern or AWWA C153 compact pattern.
    - c. Joints: bell and spigot with push-on joints and gaskets.
    - d. Gaskets: AWWA C111, rubber.
    - e. Interior lining: epoxy coating (do not use cement mortar lining).
    - f. Polyethylene encasement: AWWA C105 tube or sheet, Linear Low Density (LLD, minimum 8 mil) or High Density Cross Laminated (HDCL, minimum 4 mil) with 2" polyethylene tape (minimum 12 mil).
    - g. Application: Sewers 6" and larger. Required when crossing water lines with less than 18" vertical or 10' horizontal clearance.
- C. End Sections:
  - 1. Precast reinforced concrete for RCP piping.



2. Metal end sections for HDPE.

## 2.2 EXTERIOR CLEANOUTS

### A. General:

1. Unless otherwise indicated, cleanouts shall be the same diameter as the sewer they serve for pipe sizes up to 8", pipes greater than 8" shall use an 8" cleanout.
2. Unless otherwise indicated, riser pipes and cleanout bodies shall be the same material as the sewer they serve.
3. Each cleanout shall have an exterior housing to prevent transfer of load to the cleanout.
4. Medium duty housings may be used in non-vehicular areas, all others shall be heavy duty.
5. Exterior housing:
  - a. ASME A112.36.2M gray iron with round, secured, scoriae and gray iron cover.
  - b. Refer to Part 3 for concrete anchorage.
6. Cast iron cleanouts:
  - a. Gray iron ferrule with tapered-thread, brass closure plug, ASME A112.36.2M.
  - b. Riser pipe and fittings: cast iron soil pipe, ASTM A74.
  - c. Ferrule connection may be inside caulk, spigot or no-hub; however, connection must be water and air-tight.
7. Plastic cleanouts:
  - a. PVC body with PVC tapered-thread plug.
  - b. Riser pipe and fittings: SDR 35, ASTM D3034.

## 2.3 MANHOLES AND CATCH BASINS

### A. General:

1. Precast concrete per ASTM C478.
2. Manhole base shall be minimum 8" thick. To prevent flotation, increase thickness of precast sections or add concrete to base section as required.
3. Steps: Polypropylene encased #4 rebar per ASTM D4101, meeting OSHA requirements.
4. Castings: All frames and castings shall be heavy duty and constructed of gray iron free from blowholes, porosity, hard spots, shrinkage distortion, etc. They shall be smooth and clean.
5. Adjusting rings: Precast concrete, interlocking with ½ butyl rubber base or extrudable preformed gasket material. Bricks, blocks or other means are not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping:

1. Cleanouts and manholes shall be installed in sewer where shown on the Drawings and as required by applicable Codes and/or field conditions.
2. Install manholes and cleanouts at all changes in direction. Blind turns or gradual deflection of pipe is not permitted.
3. The maximum distance between manholes is 400'.
4. Verify existing and proposed grades, connections and pipe sizes before installing any pipe. Notify Architect/Engineer of any conflicts with Drawings or Specifications.
5. Pipe installation shall proceed upgrade with spigot ends of bell and spigot pipe pointing into direction of flow.
6. Each pipe shall be laid true to line and grade and in such a manner as to form a close concentric joint with adjoining pipe and to prevent sudden offset in the flow line.
7. During backfilling, install detectable warning tape. See Division 33 Section "Common Work Results for Utilities" for warning tape requirements.
8. Pipe trenches shall be excavated parallel to the specified pipe, slope and grade.
9. The bottom of the pipe shall be supported by a minimum 6" thick layer of #8 crushed stone. The #8 crushed stone shall extend 6" on each side of the pipe and 12" above the top of the pipe unless indicated otherwise.
10. The remaining backfill in lawn and non-pavement areas shall be suitable fill material approved by the soils testing laboratory.
11. Pipes under and within 5' of pavements, slabs, sidewalks and other hard surfaces shall be backfilled with compacted granular fill.
12. All backfilling and compaction shall be in accordance with Division 31 Section "Earthwork"
13. Any breaks or defects in pipe must be immediately repaired. Any pipe which has been disturbed after being laid must be taken up, joints cleaned and properly relaid.
14. Interior of all pipe shall be cleaned of all dirt and superfluous materials as the work progresses. After pipe installation, install erosion control measures as shown on Drawings and as necessary to prevent sediment or other materials from entering or building up in pipe.
15. Water and sewer minimum clearances:
  - a. Where minimum 18" vertical or 10' horizontal separation cannot be provided between sewers and water lines, the sewer shall be ductile iron, refer to Part 2.
  - b. At crossings, extend ductile iron sewer pipe a minimum of 10 feet on both sides of the water line.
  - c. Do not install water and sewer lines in the same trench under any circumstances.

B. Manholes and Catch Basins:

1. Set solid lid castings flush with grade in pavement areas and 1" above grade in other areas. Set inlet castings at elevation grades per Drawings.
2. Install 2 to 4 precast adjusting rings for an overall 6" to 12" adjustment height.
3. Grade to drain into inlet castings positively and adequately.
4. Install steps from 12" below top to 12" above bottom at 16" on center.
5. Bench bottom of structures per Drawings.

C. Cleanouts:

1. Install piping so cleanouts open in direction of flow in sewer pipe.
2. Set cleanout covers flush with grade.
3. In areas other than concrete walks and concrete pavements, install concrete anchor pad.
4. Unless otherwise indicated, pad dimensions are 12" height with a diameter of the cleanout housing diameter + 12", to provide a 6" ring around the cleanout frame. Place on properly compacted subgrade and stone per Division 31 Section "Earthwork" and Division 32 Section "Site Concrete".

END OF SECTION 33 40 00





